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(12) **United States Patent**
Frick

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(45) **Date of Patent: Mar. 7, 2017**

(54) **LADDER**

(76) Inventor: **Rory Frick**, Aledo, IL (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 45 days.

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(22) Filed: **Feb. 21, 2011**

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US 2011/0139544 A1 Jun. 16, 2011

Related U.S. Application Data

(63) Continuation-in-part of application No. PCT/US2009/054630, filed on Aug. 21, 2009.

(60) Provisional application No. 61/430,331, filed on Jan. 6, 2011.

(51) **Int. Cl.**

E06C 7/18	(2006.01)
E04F 11/00	(2006.01)
E06C 1/22	(2006.01)
E06C 1/383	(2006.01)
E06C 1/397	(2006.01)
E06C 7/42	(2006.01)
E04F 11/06	(2006.01)

(52) **U.S. Cl.**

CPC ***E06C 7/183*** (2013.01); ***E04F 11/002*** (2013.01); ***E04F 11/06*** (2013.01); ***E06C 1/22*** (2013.01); ***E06C 1/383*** (2013.01); ***E06C 1/397*** (2013.01); ***E06C 7/42*** (2013.01); *E04F 2011/005* (2013.01)

(58) **Field of Classification Search**

CPC B63B 24/14; E04G 1/34; E04C 9/10
USPC 182/1, 152, 161, 21
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

34,314	A	2/1862	Monson	
60,731	A *	1/1867	Hovey	B63B 27/14 182/1
419,821	A *	1/1890	Burrows	E06C 1/383 182/161
538,145	A *	4/1895	Allen	A47B 43/00 108/1
739,085	A *	9/1903	Kamerer	A47B 57/04 108/1
946,588	A *	1/1910	Thuener	188/65.4

(Continued)

FOREIGN PATENT DOCUMENTS

GB	2426029	A *	11/2006	E04F 11/0255
GB	2426029	B *	10/2007	E04F 11/0255
WO	WO 2009025642	A1 *	2/2009	B60R 3/005

OTHER PUBLICATIONS

Cotterman Bulletin DT-1013D—Dual Trak® Ladder System brochure.

(Continued)

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(57) **ABSTRACT**

A ladder having platform steps, the ladder being convertible between a deployed position for supporting a person or other load, to a storage, scaffold, or ramp position in which the steps lie in a generally planar arrangement. When deployed, the ladder steps remain parallel to each other and form a series of parallelograms with the rails of the ladder. The ladder is also capable of being locked or secured at various angles of deployment. The ladder further includes receivers to selectively receive accessories such as wheels, hooks, handles, or pads. The addition of accessories such as wheels

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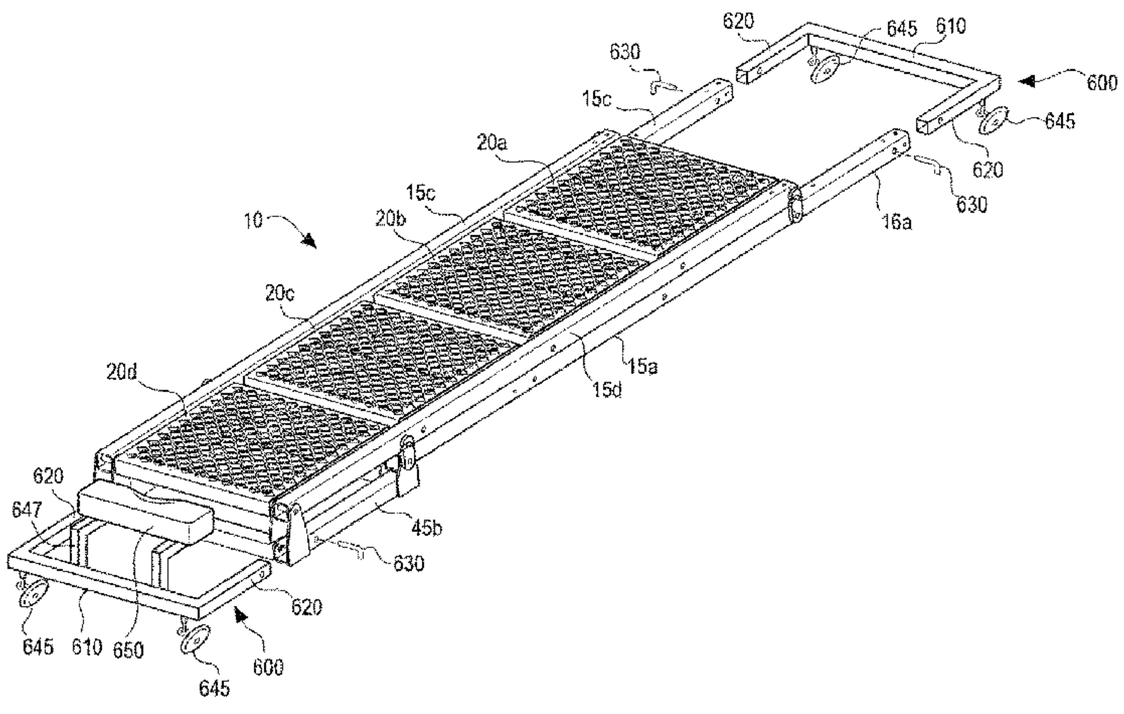


allows the ladder in the storage position to be used as a creeper, dolly, or cart.

17 Claims, 21 Drawing Sheets

(56) **References Cited**

U.S. PATENT DOCUMENTS

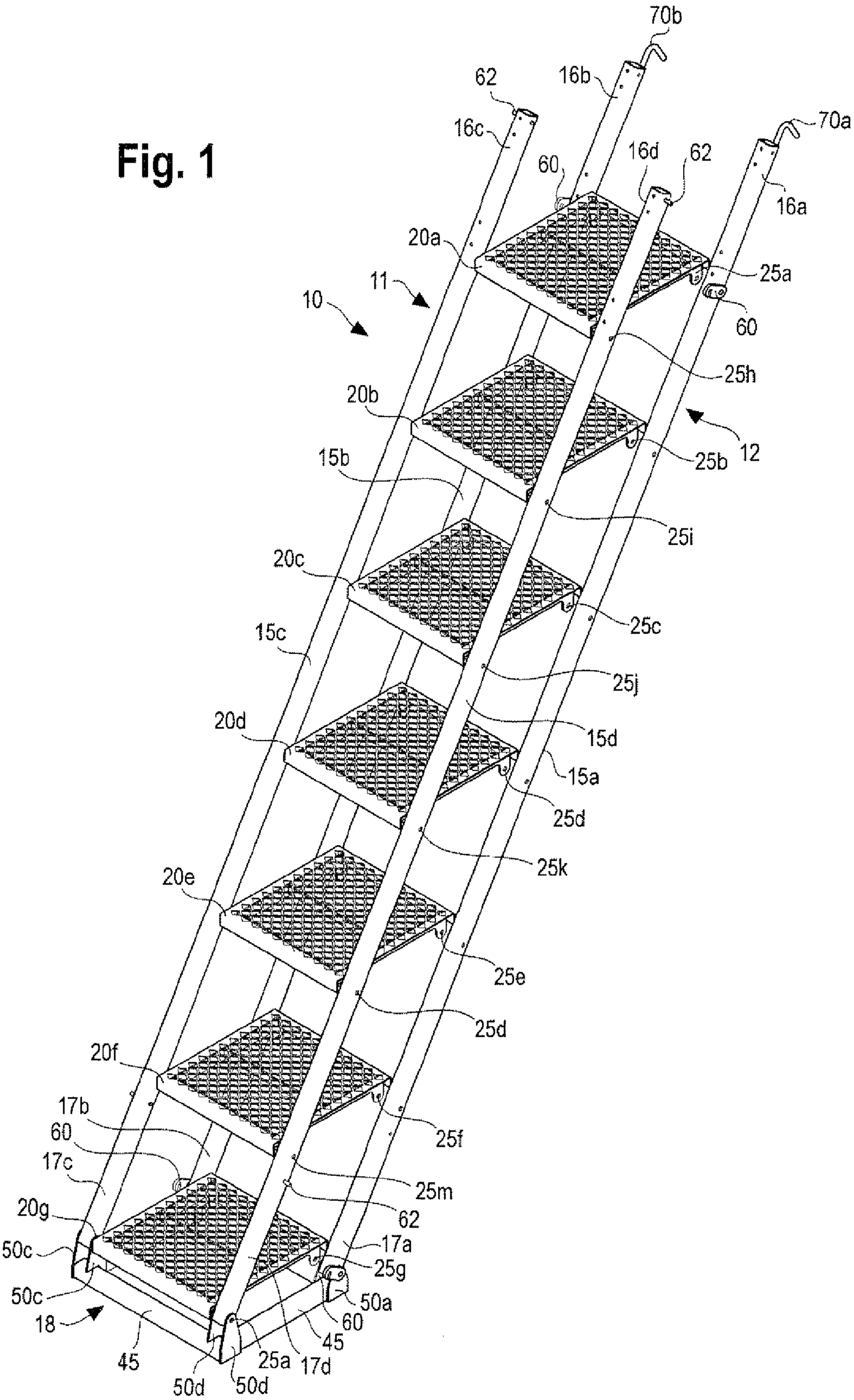
1,232,221	A		7/1917	Chesebro	
1,419,834	A	*	6/1922	Fellows	E04F 11/04 182/1
1,791,330	A	*	2/1931	Sprague	E06C 1/387 182/156
2,220,155	A		11/1940	Frank	
2,245,825	A	*	6/1941	Ross	A47C 1/12 108/1
3,026,961	A		3/1962	Leverett	
3,446,311	A	*	5/1969	Alfie	E06C 1/387 182/116
3,463,265	A	*	8/1969	Clover	E04G 1/34 182/119
3,493,077	A	*	2/1970	Doten	B60R 3/02 182/156
3,498,412	A	*	3/1970	Best	E04G 1/00 182/113
3,626,438	A		12/1971	Cornell	
3,814,210	A	*	6/1974	Hoffman	182/6
3,876,036	A	*	4/1975	Sweet	182/18
4,004,652	A	*	1/1977	Laboy-Alvarado	E01D 15/124 182/1
4,053,028	A	*	10/1977	Loix	E06C 1/20 182/1
4,119,175	A	*	10/1978	Herwynen	E06C 1/393 182/125
4,258,826	A	*	3/1981	Murray	B62B 1/002 182/103
4,399,889	A	*	8/1983	Todd	182/6
4,493,392	A	*	1/1985	Alimbau Marques	E06C 1/12 182/164
4,494,629	A	*	1/1985	Raeburn	188/65.5
4,502,564	A	*	3/1985	K/u/ mmerlin	E06C 1/16 182/161
4,580,658	A	*	4/1986	Brda	182/5
4,596,314	A	*	6/1986	Rogelja	188/65.5
4,648,481	A	*	3/1987	Lee	A47C 12/02 182/106
4,723,631	A		2/1988	Tremblay	
4,989,692	A	*	2/1991	Min	E06C 1/125 182/166
5,279,387	A	*	1/1994	Swiderski	E06C 1/32 182/108
5,395,154	A	*	3/1995	Wang	A47D 1/02 280/30
D383,336	S	*	9/1997	Van Der Merwe	D34/21
5,762,163	A		6/1998	Kain	
5,845,894	A	*	12/1998	Petzl et al.	254/391
6,009,977	A	*	1/2000	Pelofi	182/192
6,029,777	A	*	2/2000	Rogelja	182/193
6,068,277	A	*	5/2000	Magnussen	E02F 9/0833 182/127
6,189,653	B1	*	2/2001	Laug	E06C 1/39 182/152
6,206,139	B1		3/2001	Bogart, Jr.	
6,378,650	B2	*	4/2002	Mauthner	182/5
6,446,753	B1	*	9/2002	Novak	182/193
6,951,265	B2	*	10/2005	Frame	B64F 1/315 182/127
6,988,586	B1	*	1/2006	Perez	E06C 1/397 182/21
6,997,282	B1	*	2/2006	Sharp	E06C 1/39 182/129
7,469,958	B2	*	12/2008	Hastings	B60P 1/435 14/2.4
7,845,467	B2	*	12/2010	Petzl et al.	182/5
8,127,890	B2	*	3/2012	Meyers	A47C 12/00 182/156
2006/0207829	A1	*	9/2006	Mauthner	182/5
2007/0056797	A1	*	3/2007	Wang	B62B 1/12 182/21
2008/0245611	A1	*	10/2008	Klingler	182/6
2008/0251319	A1	*	10/2008	Meyers	A47C 12/00 182/161
2008/0302600	A1	*	12/2008	Murray	182/5
2009/0020360	A1	*	1/2009	May	B60R 3/02 182/1
2009/0120720	A1	*	5/2009	Arms	182/193
2010/0147622	A1	*	6/2010	Fuqua	B60R 3/005 182/27
2011/0024234	A1	*	2/2011	Lin	E06C 1/387 182/161
2012/0111665	A1	*	5/2012	Paglioli	182/5
2013/0161127	A1	*	6/2013	Allred, III	E06C 1/02 182/108
2014/0054109	A1	*	2/2014	Barnett	182/5

OTHER PUBLICATIONS

Cotterman Bulletin DC-102—Rolling Metal Ladders.
Steeldeck, Inc.—Steeldeck Platform Systems Catalog—May 2007.
AimSafe—Advertising flier for "Easy Safety Stair" Models TFS30 and TFS36.

* cited by examiner

Fig. 1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25i
20c
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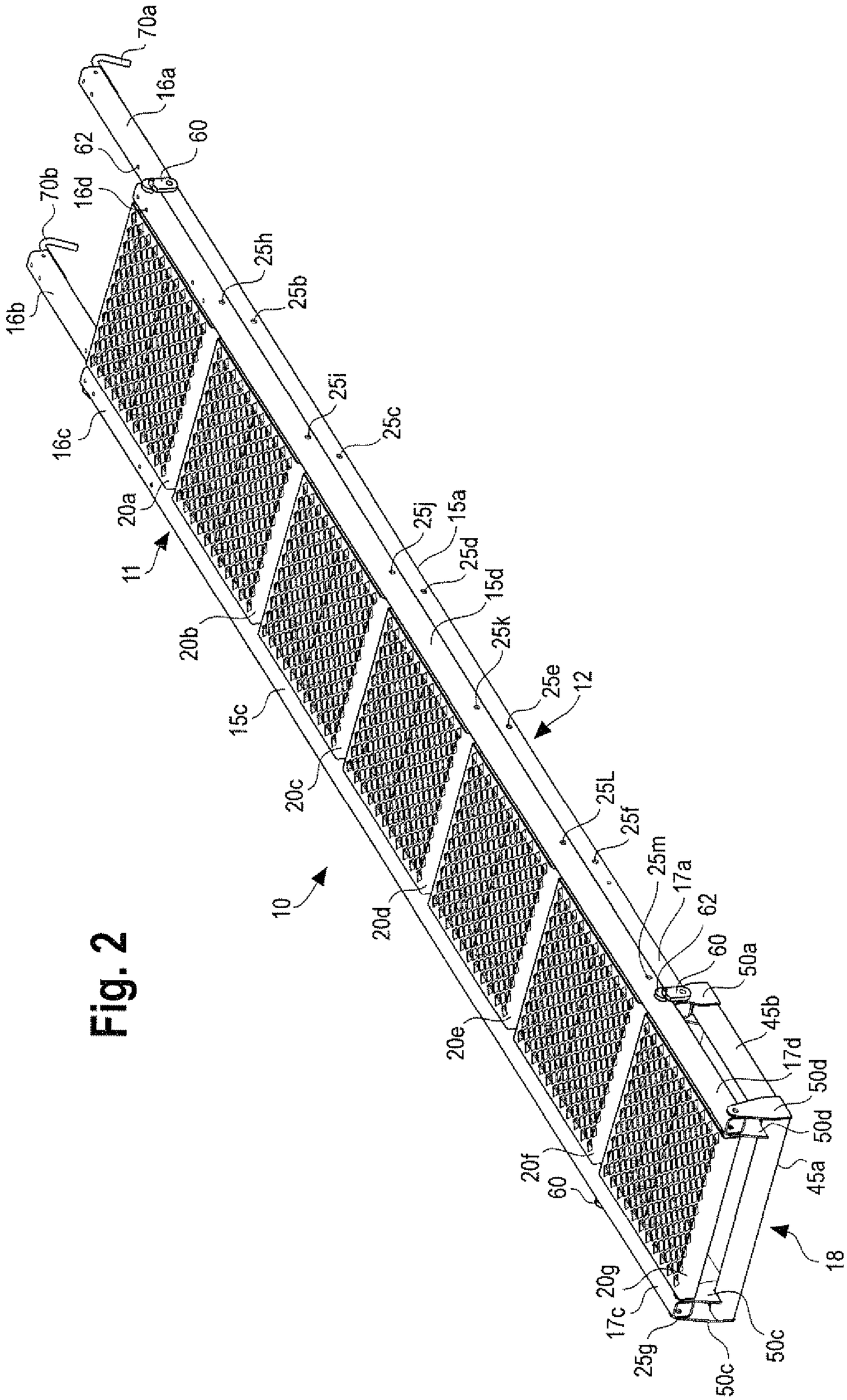
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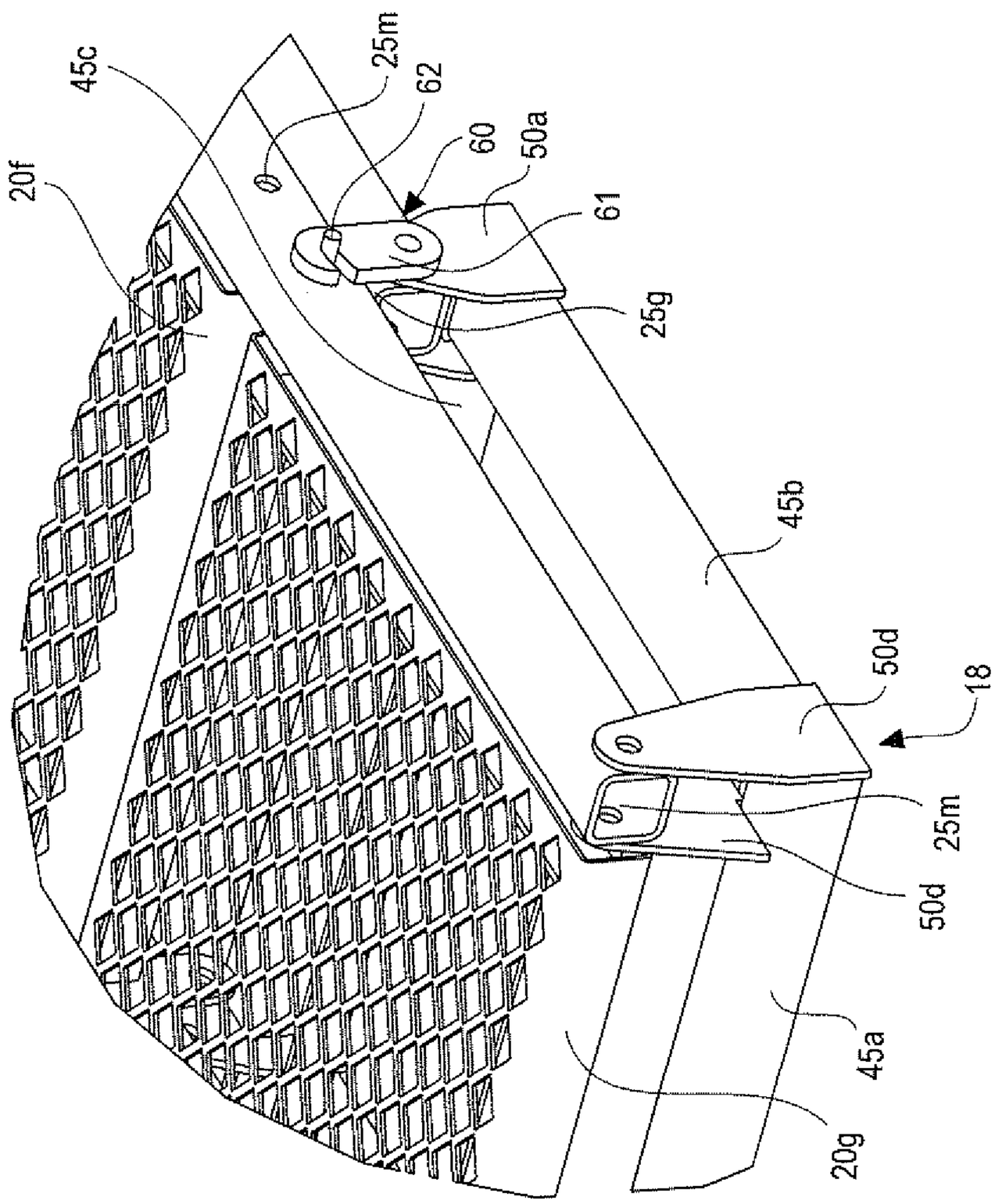
Fig. 2

Fig. 2A



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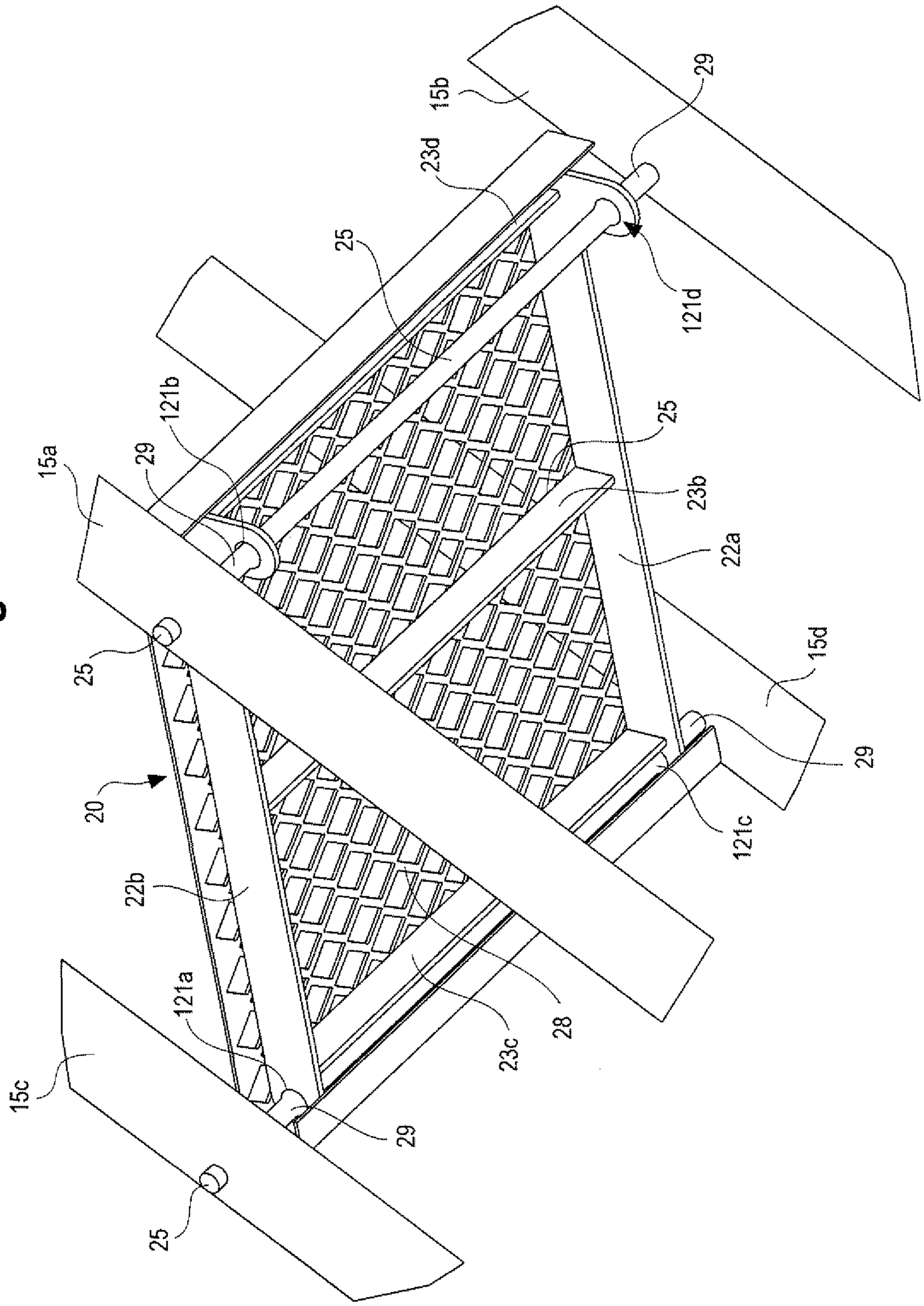
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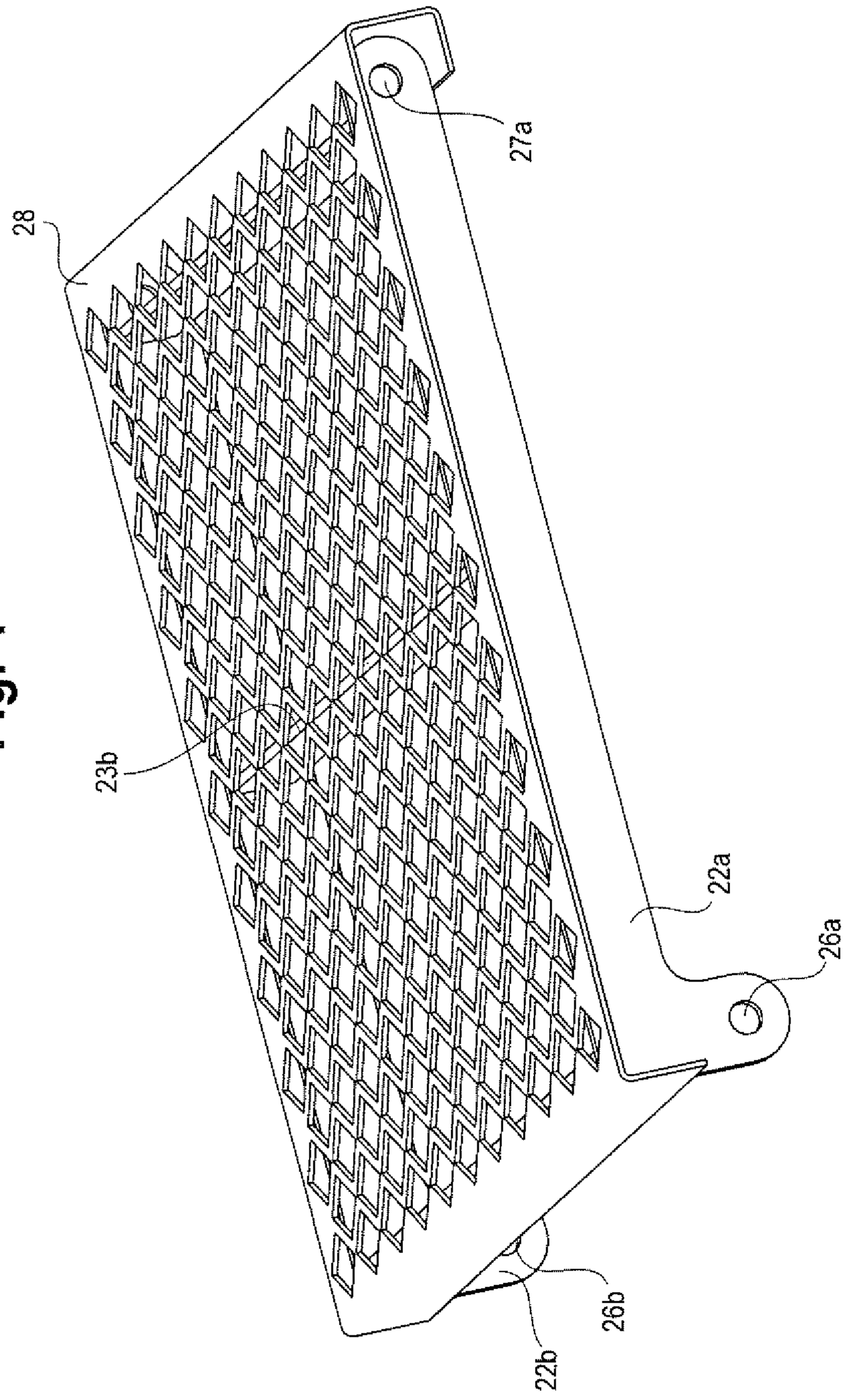
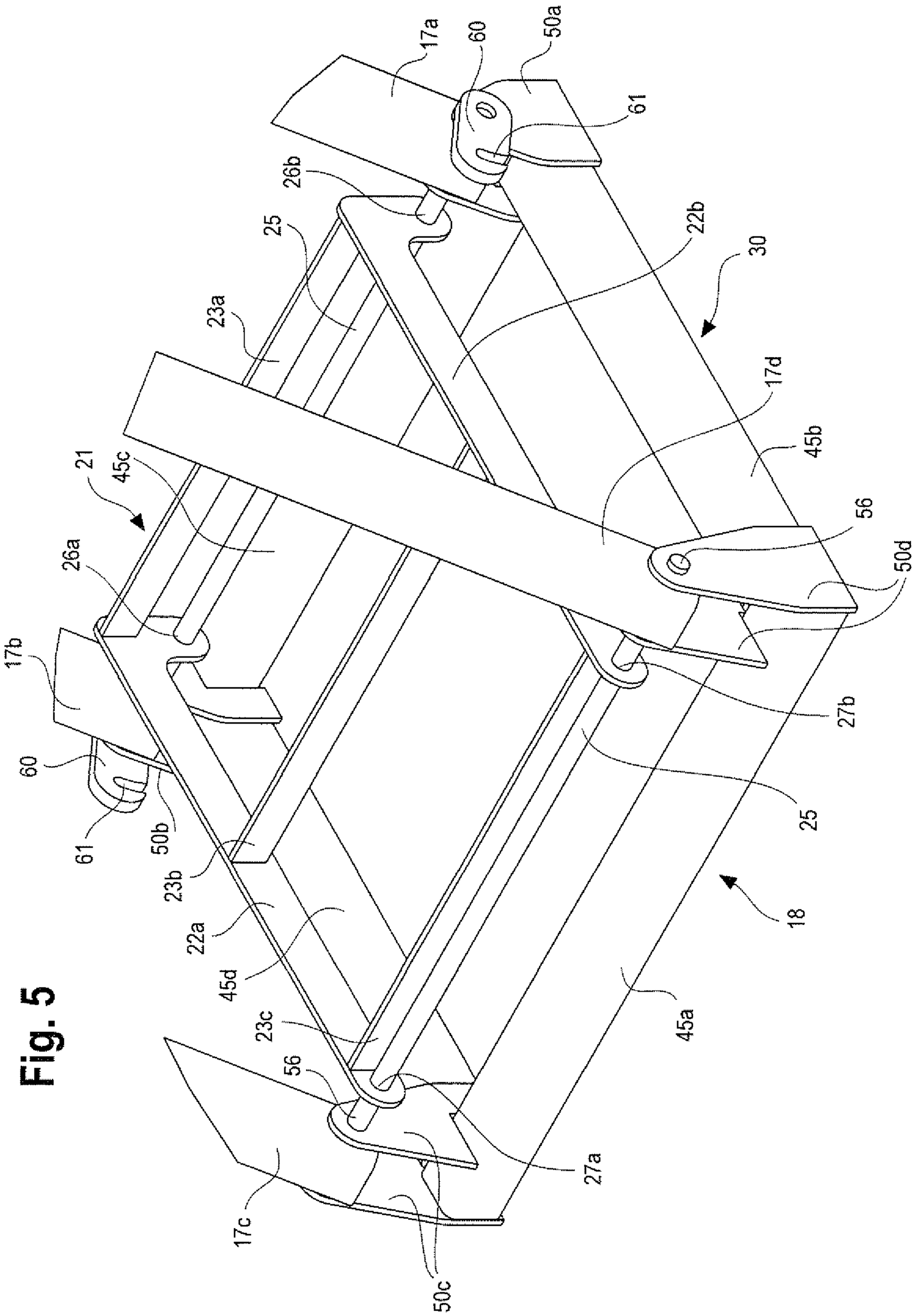
28
15c
29
25

Fig. 4

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17c
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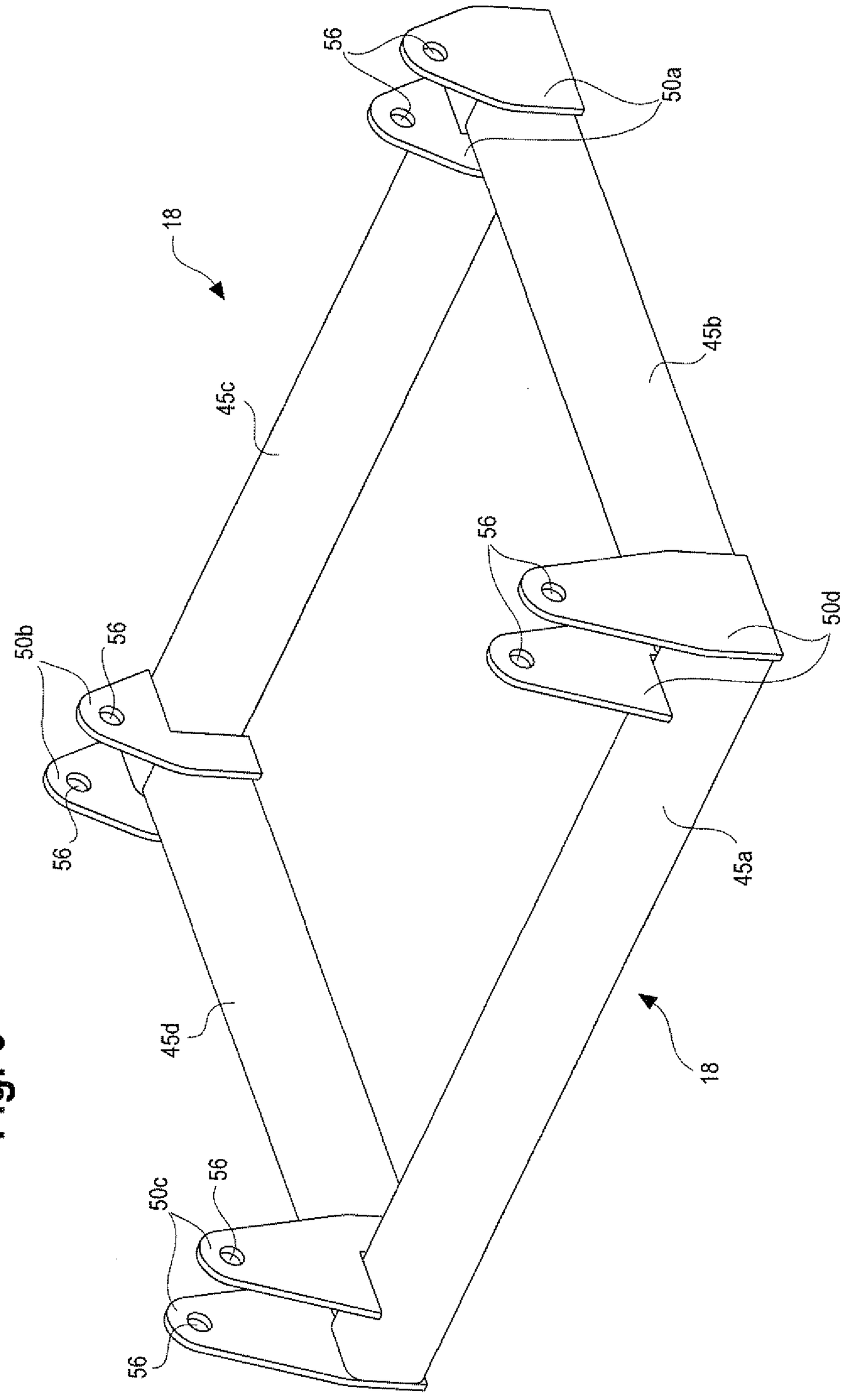

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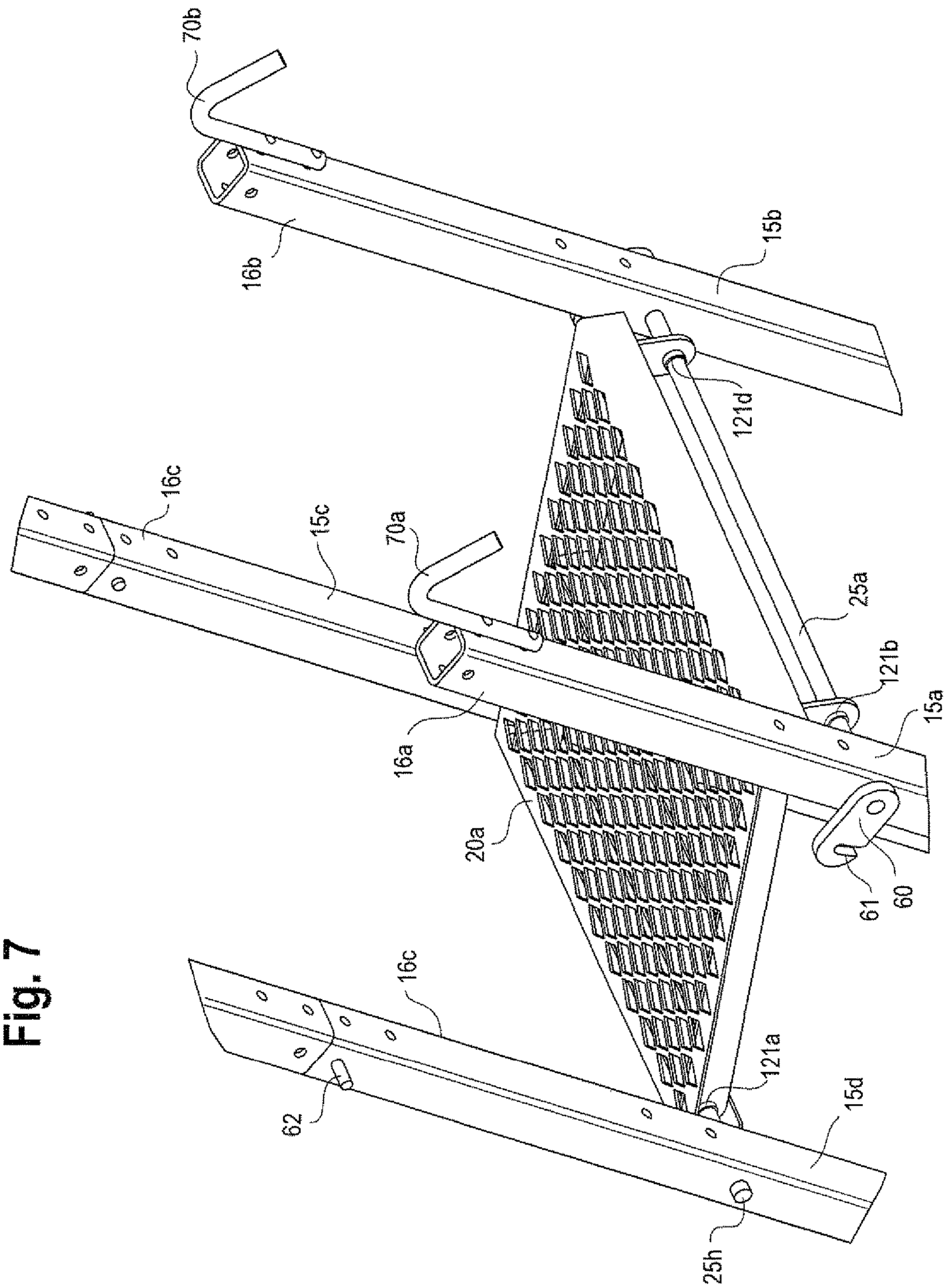
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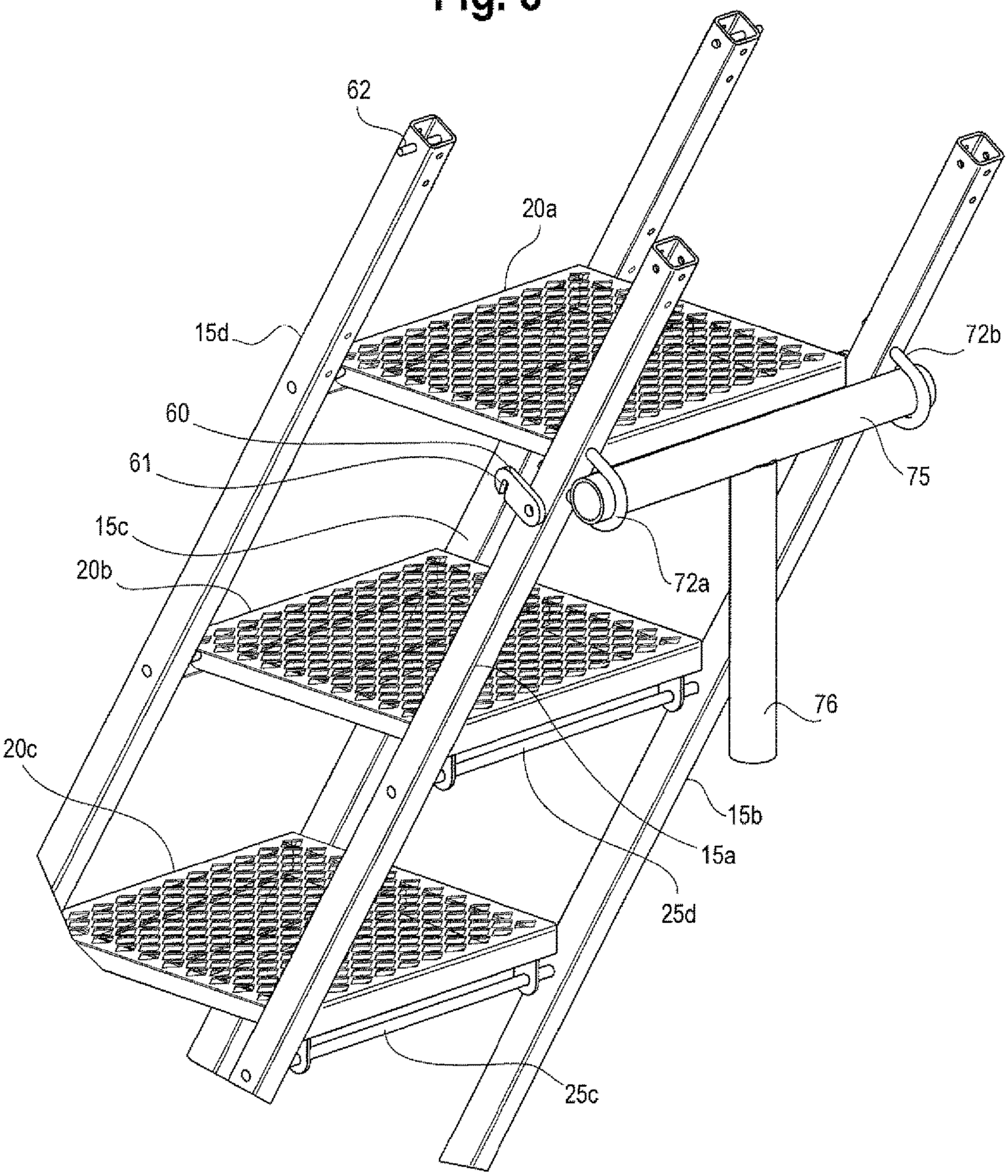
25h

Fig. 7

Fig. 8



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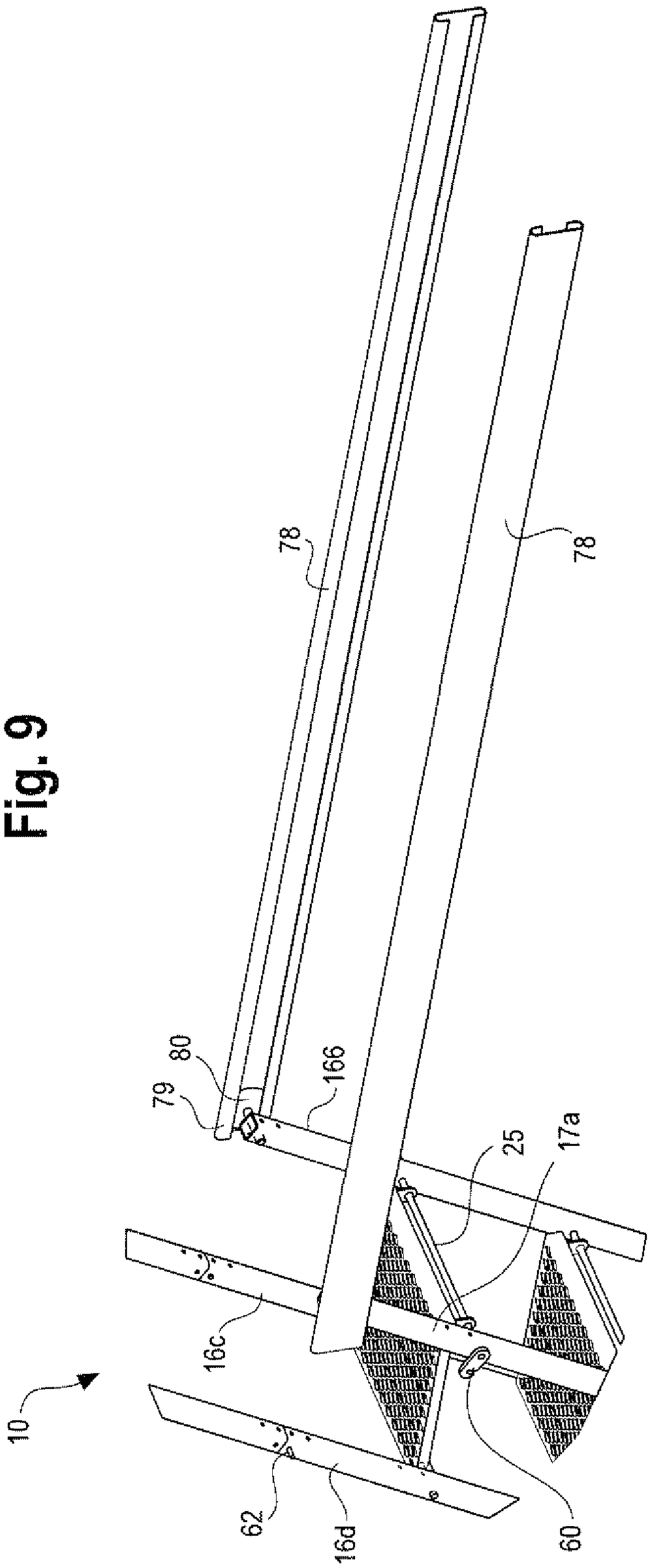

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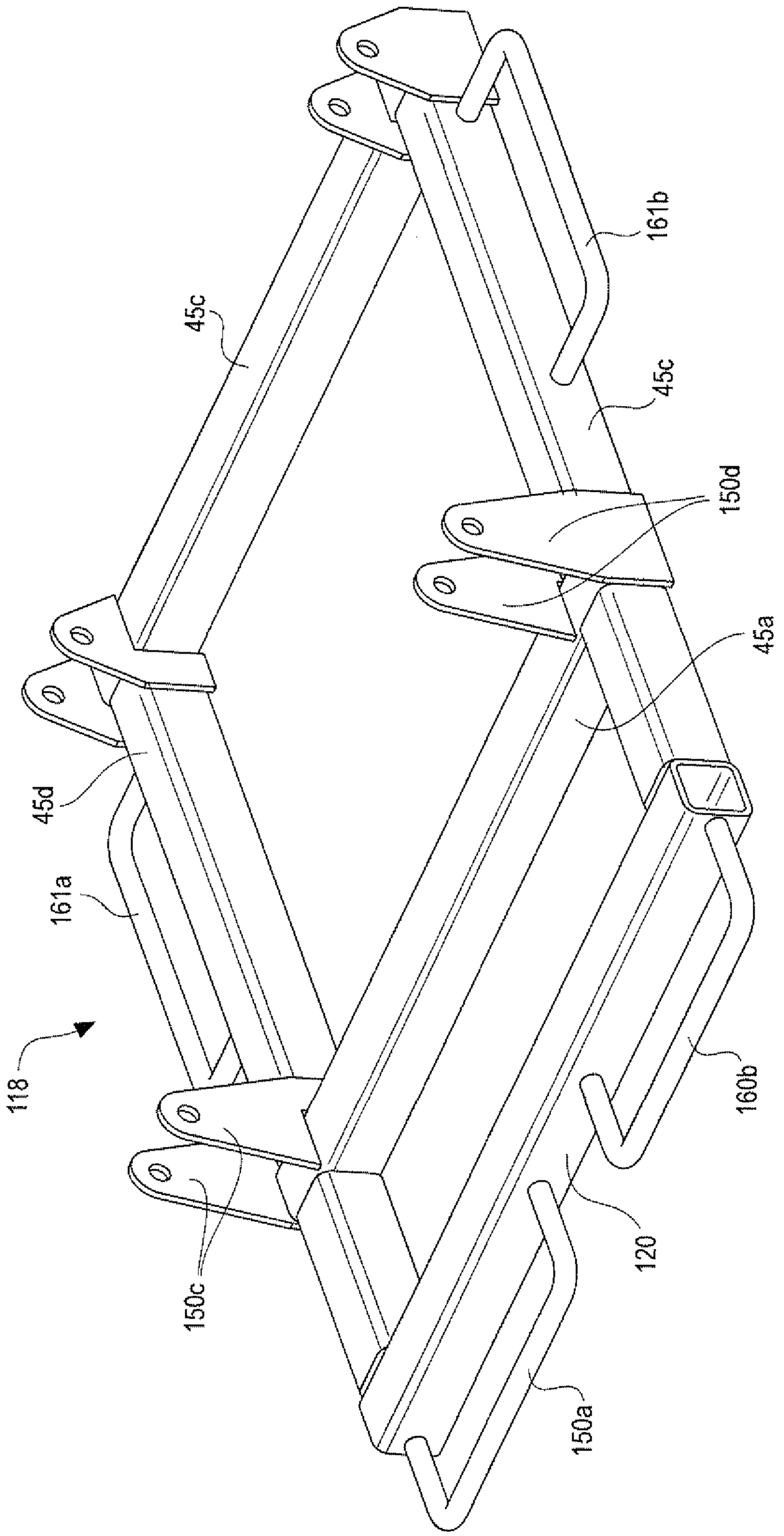

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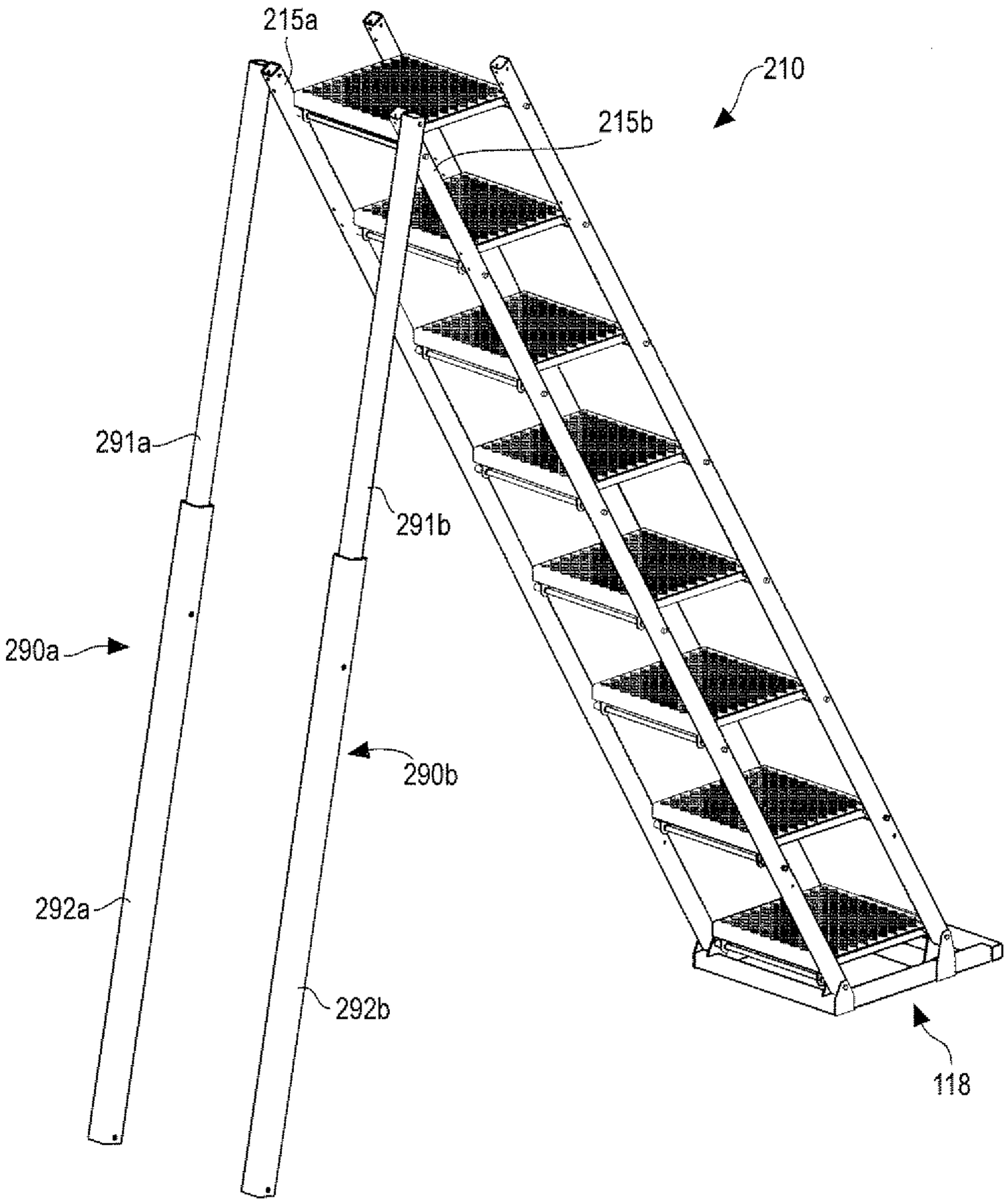

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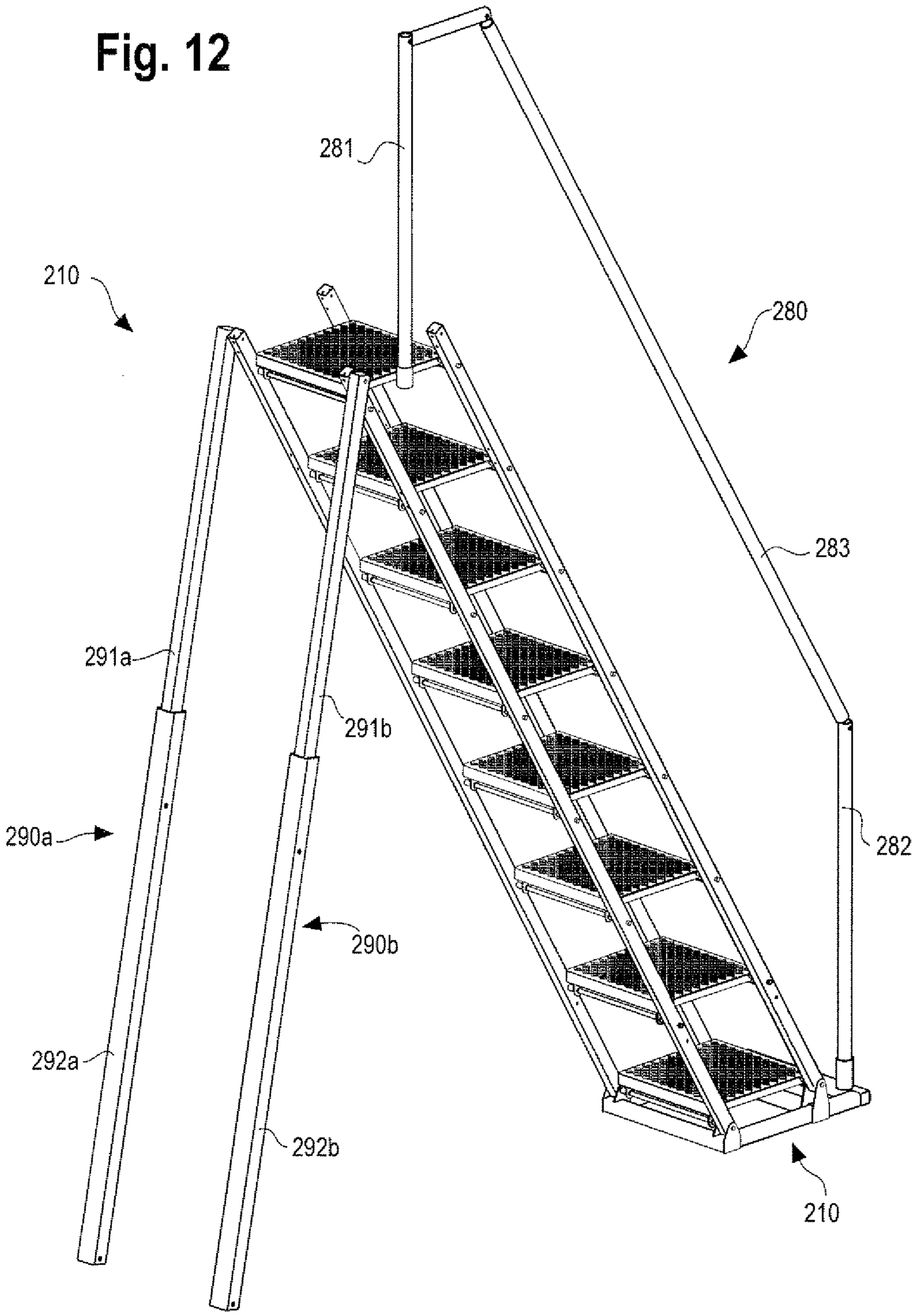

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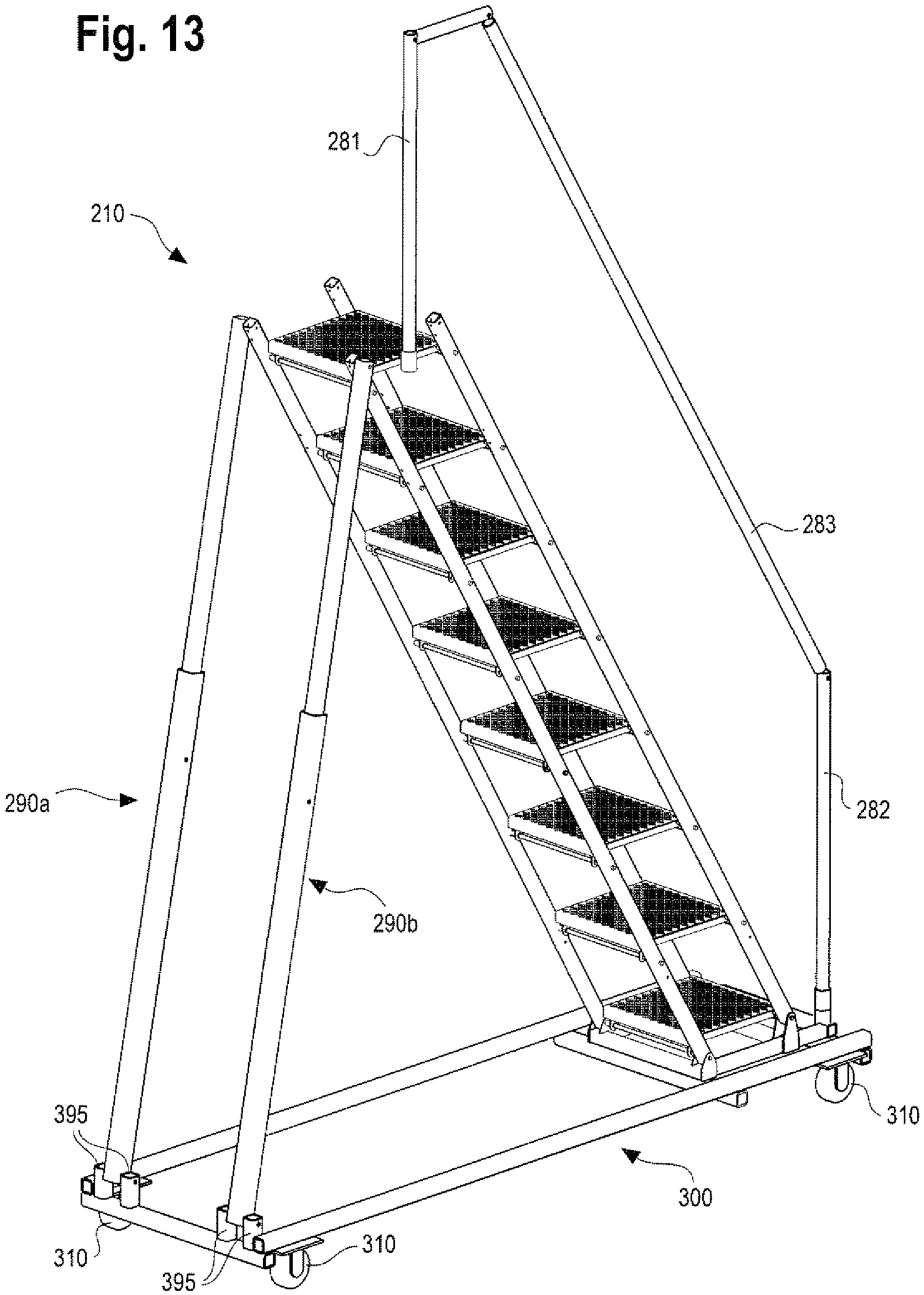

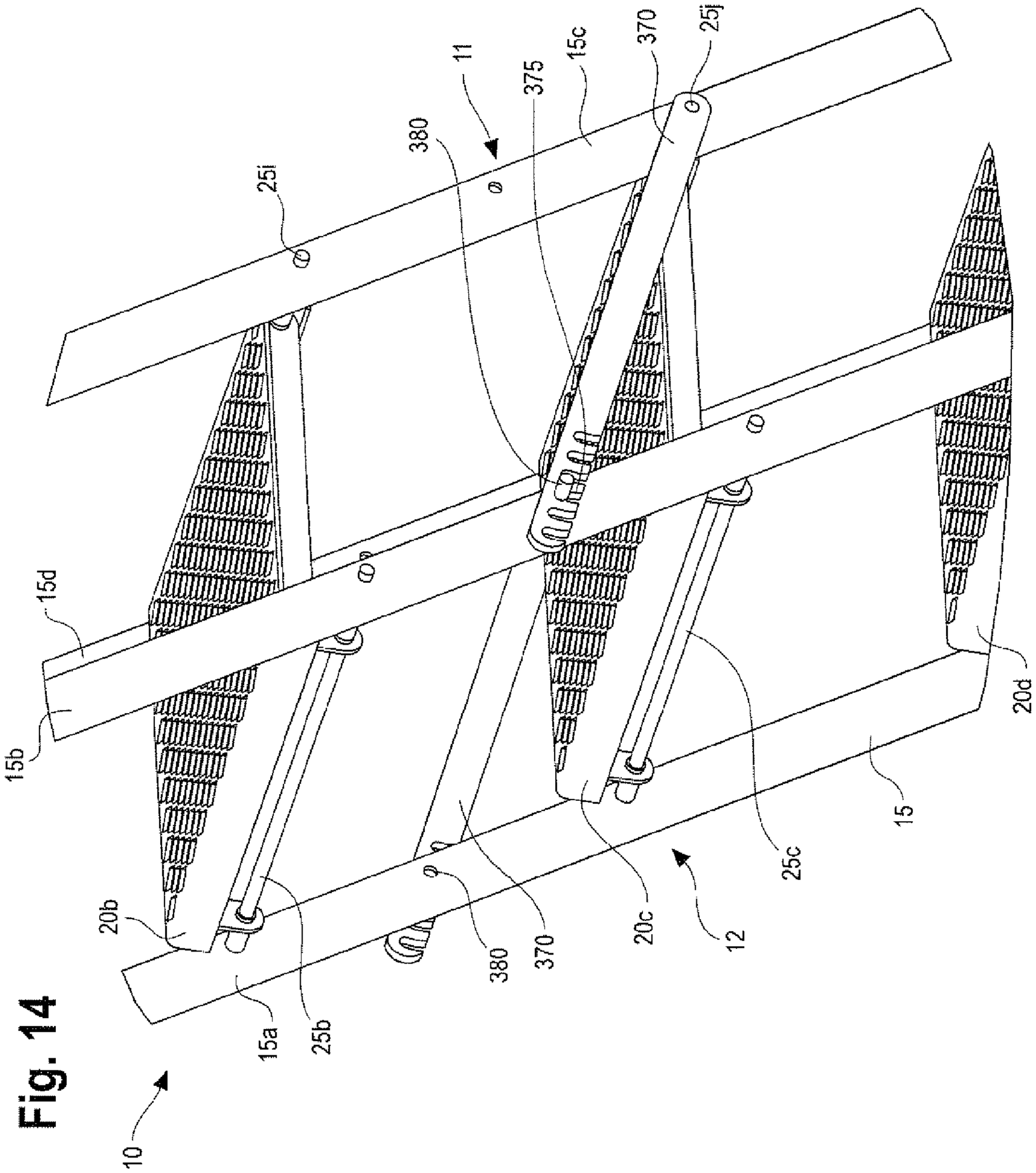
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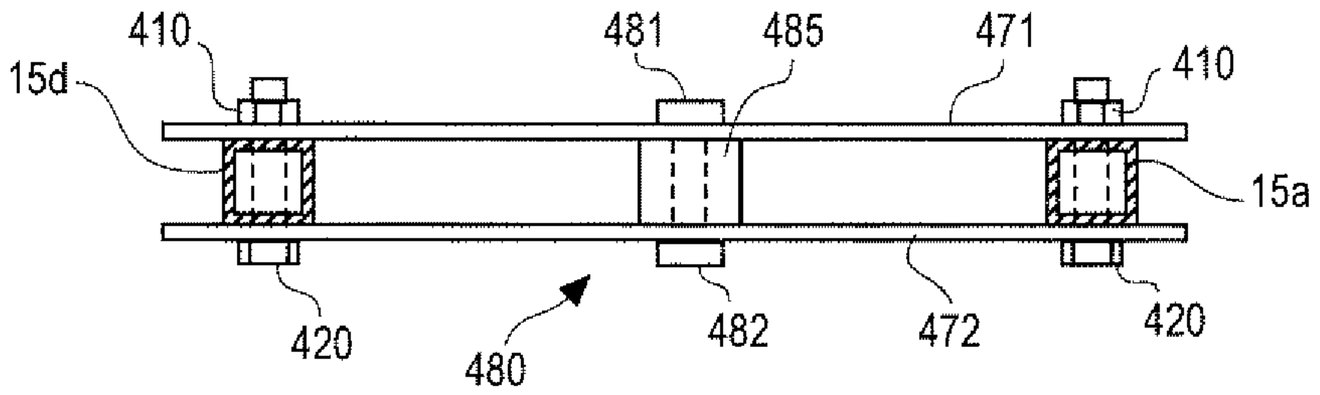
Fig. 14

Fig. 15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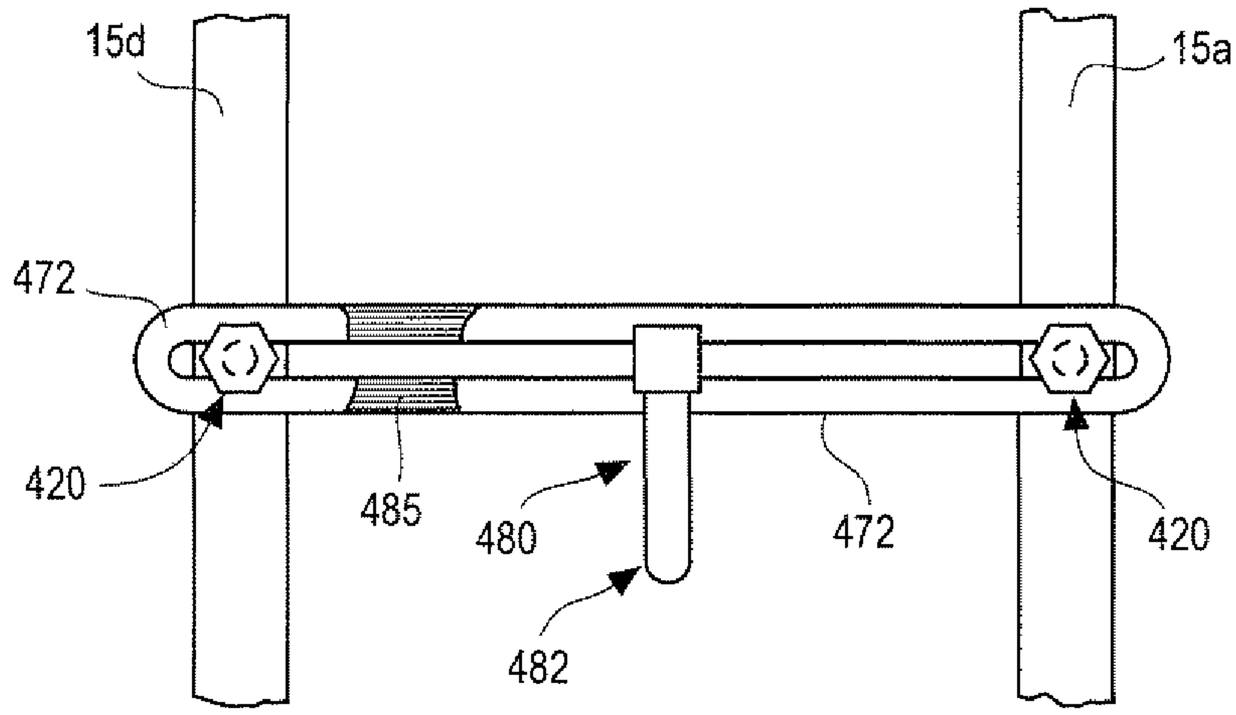
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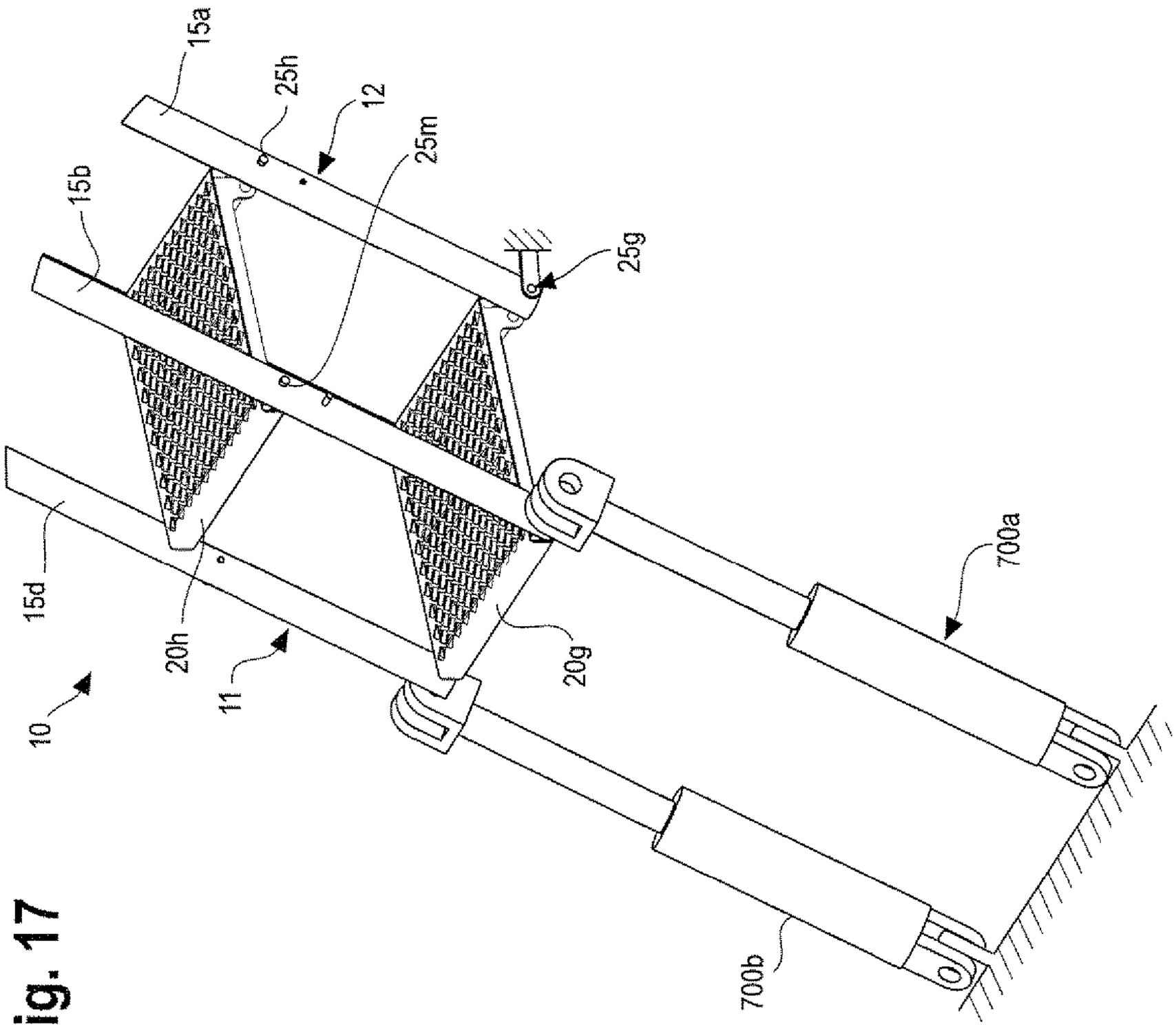
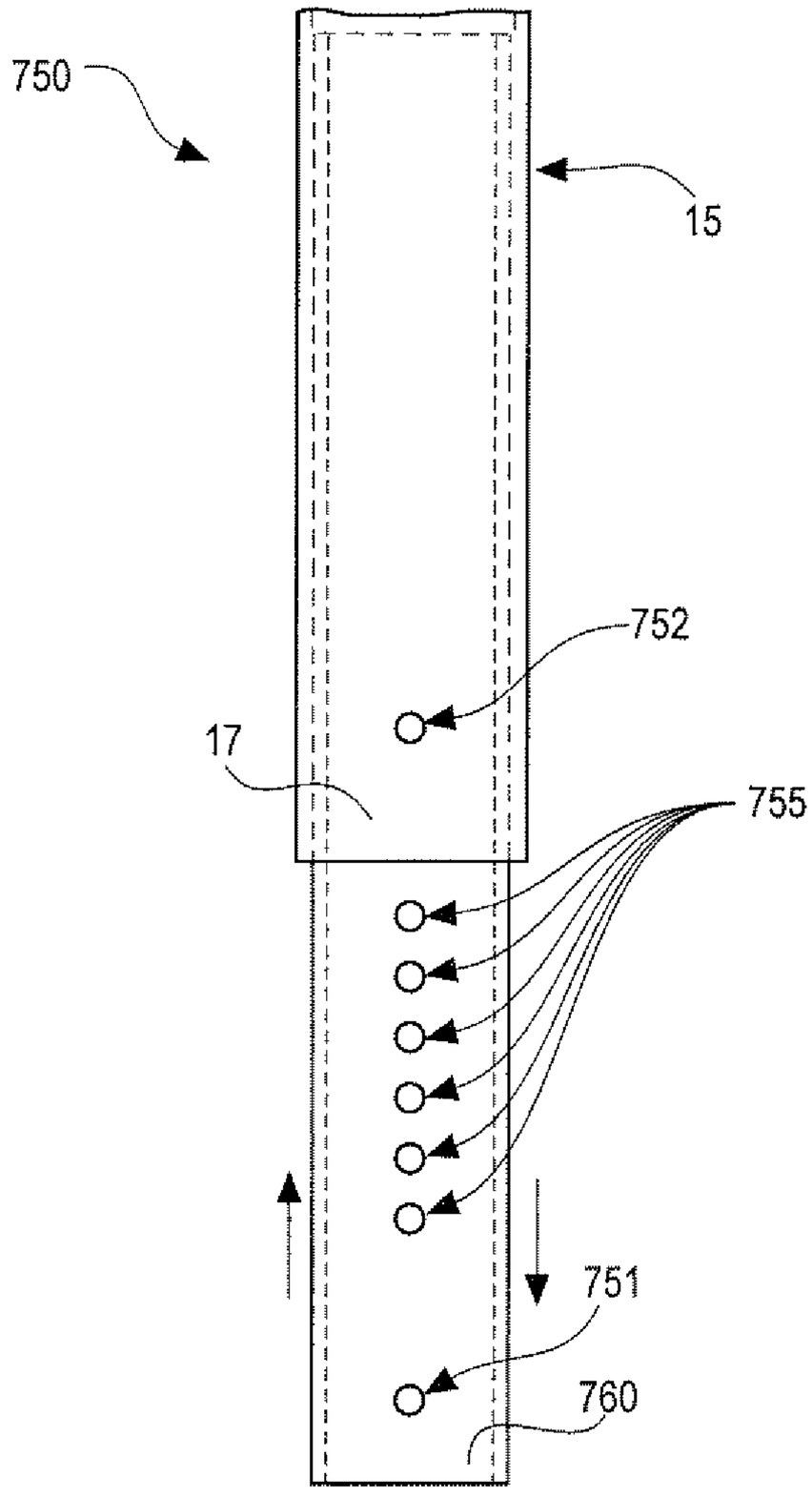


Fig. 17

Fig. 18



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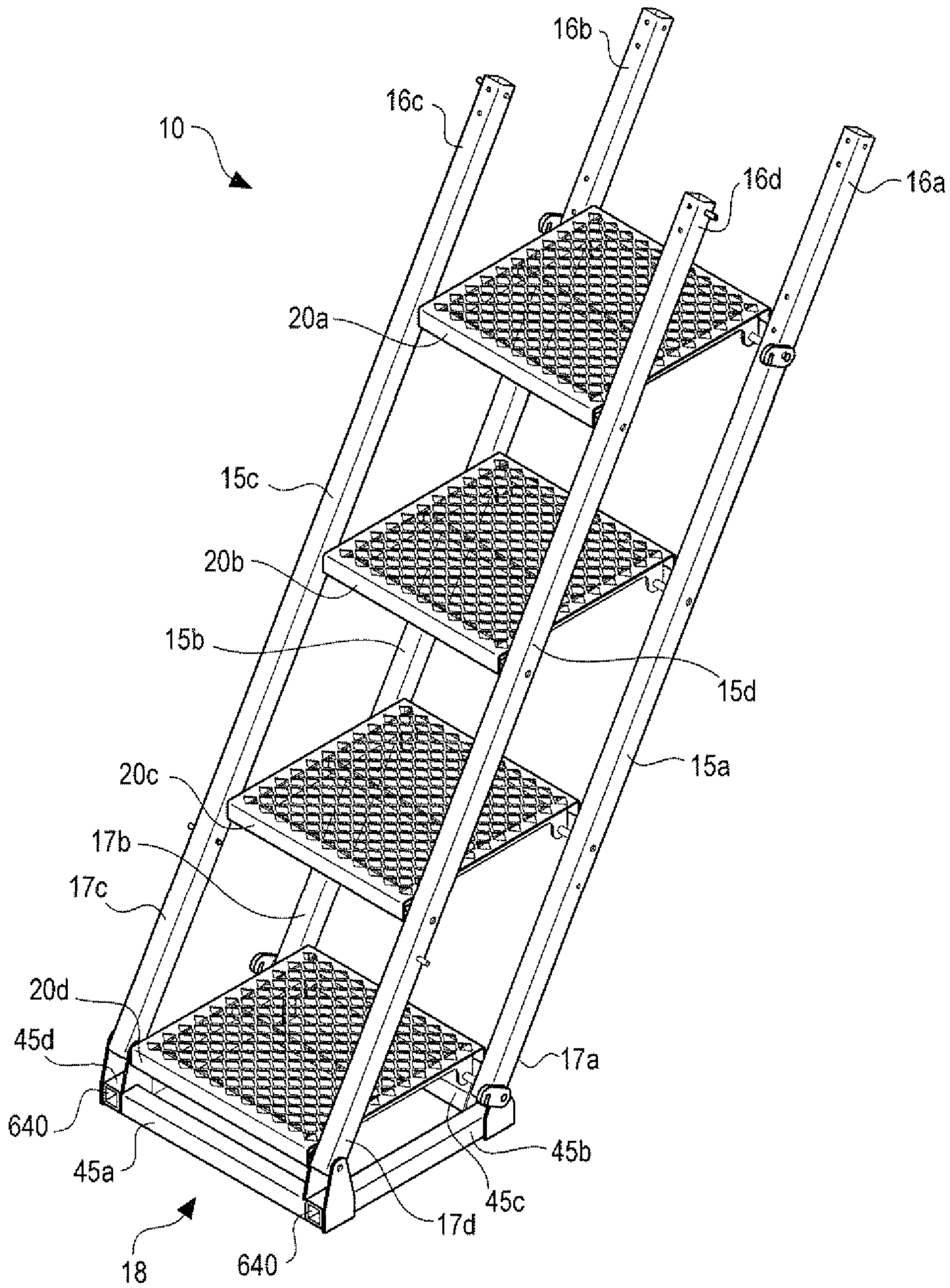
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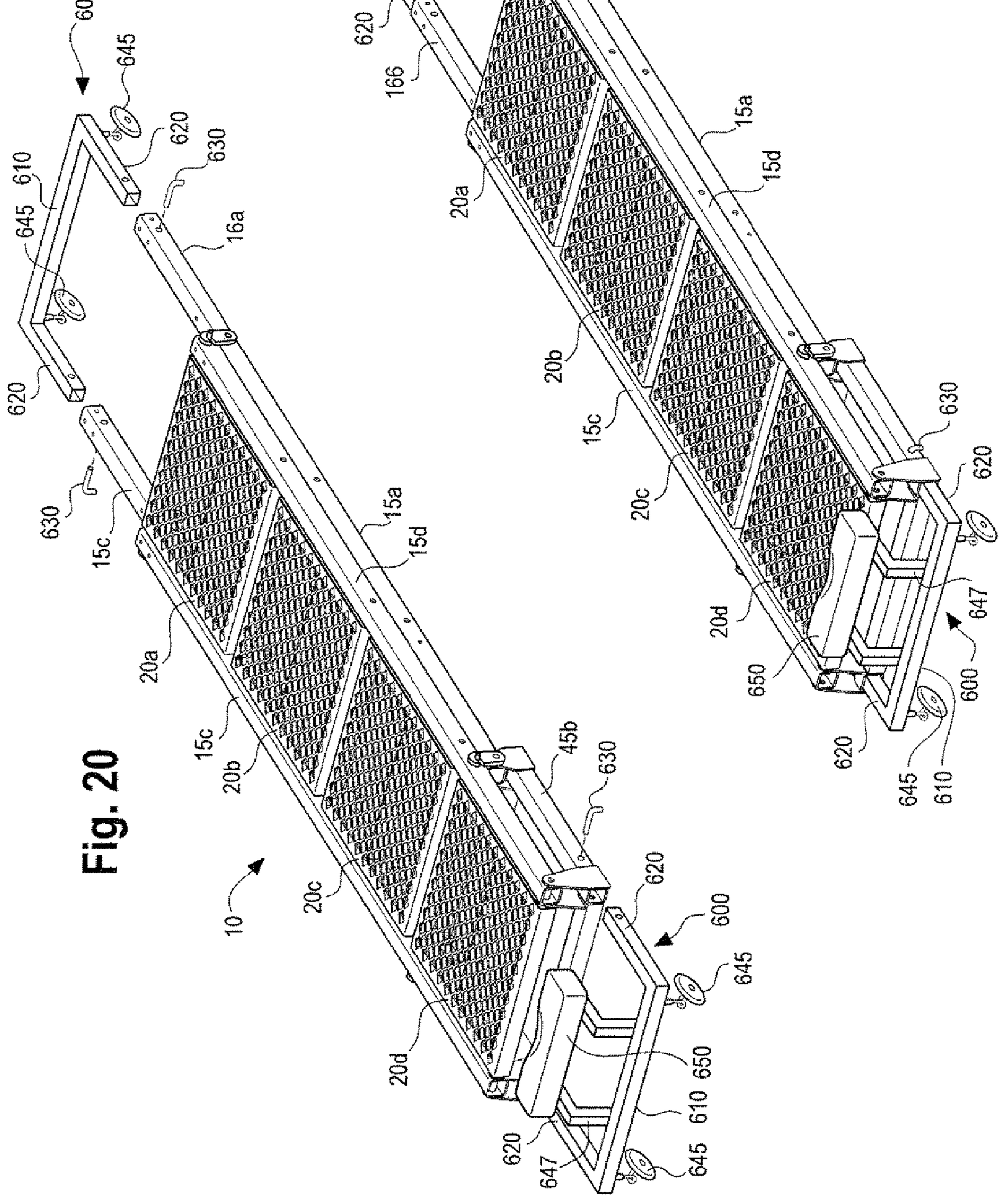
Fig. 20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20c
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15c
45b
10
647
650

Fig. 21

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20d
15c
166
650
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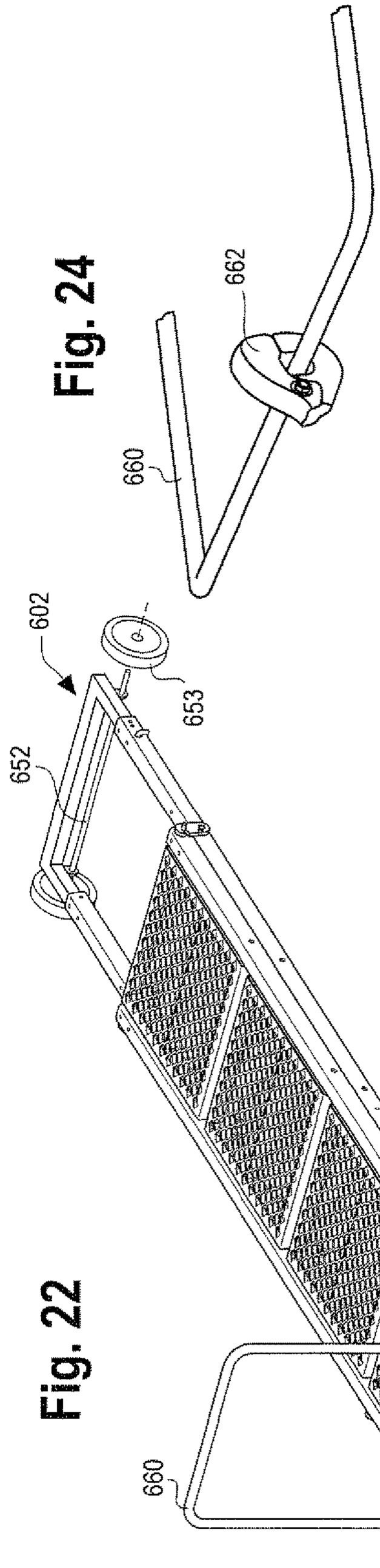

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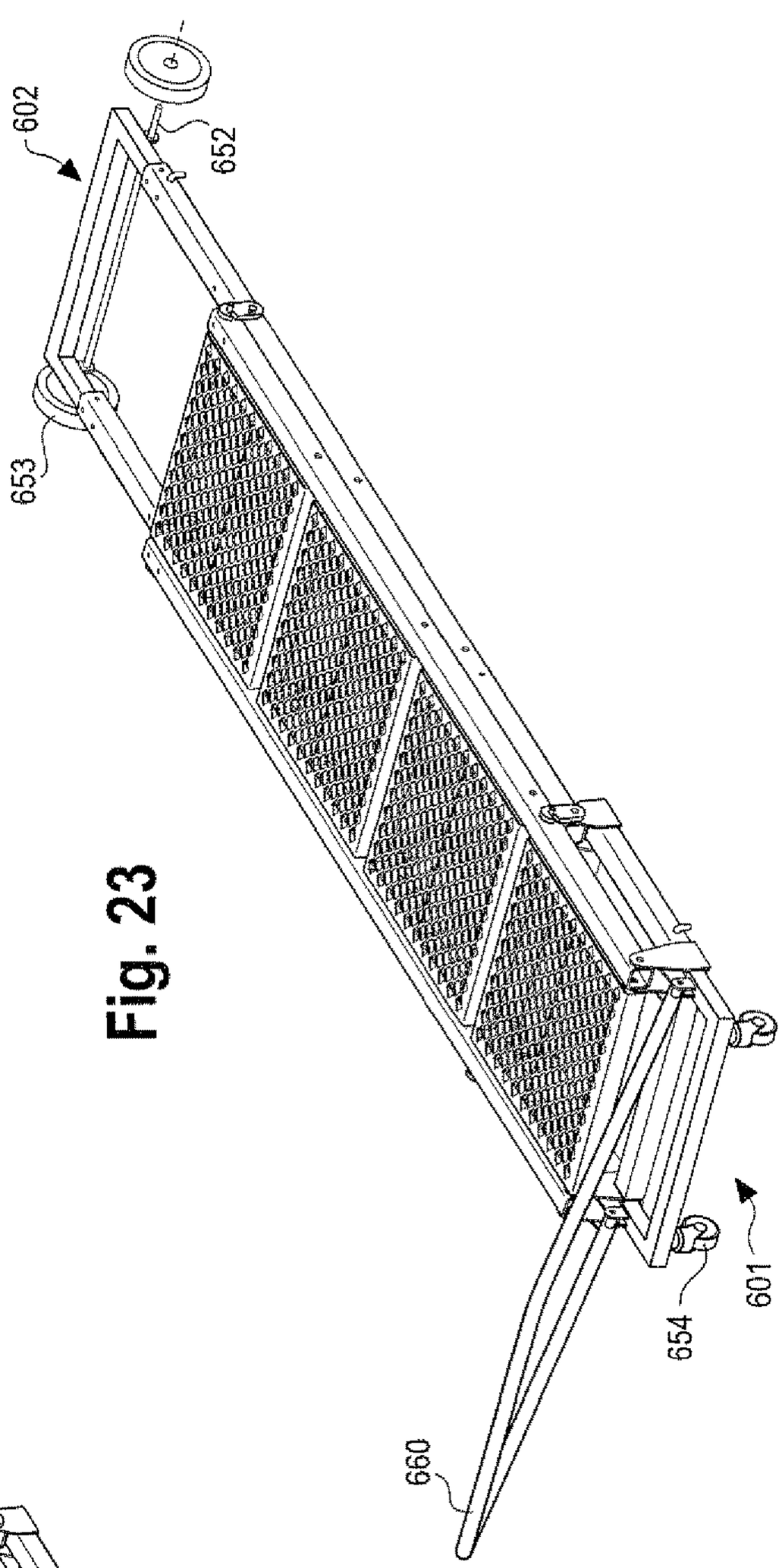

Fig. 23

Fig. 24

LADDER

RELATED APPLICATION

This application is a continuation-in-part of U.S. application Ser. No. PCT/US09/54630 filed on Aug. 21, 2009. This application also claims priority to U.S. Provisional Application No. 61/430,331 filed on Jan. 6, 2011.

FIELD OF THE INVENTION

The invention relates to the field of ladders and scaffolding, particularly ladders with platform steps and accessories that attach thereto. The invention also relates to creepers and hand carts.

BACKGROUND OF THE INVENTION

The ladder of the present invention is a platform step ladder designed to allow the ladder to be positioned at various inclinations, while allowing the platform steps to remain generally parallel to the ground. In another configuration, the platform steps of the ladder can align to form a generally or substantially continuous planar surface to allow the ladder to be used as a platform or as a ramp. In alternate embodiments, the ladder of the present invention can include mechanisms to allow the ladder to be locked or secured at a particular inclination. Additionally, the ladder can include a wheeled base to allow the ladder to be moved from place to place. In further embodiments of the invention, the ladder is constructed to accept accessory bars to permit the attachment of accessories such as wheels, to allow the ladder, when in the platform configuration, to be used as a creeper. Other accessory bars include wheels and a handle to allow the platform to be used as a cart. Other accessory bars include hooks or pads to be used on the top end of the ladder when the ladder is deployed.

SUMMARY OF THE INVENTION

The ladder base consists of a rectangular frame with four forward attachment brackets and four rear brackets extending upwards from the base. The ladder frame includes a plurality of ladder frame rails and a plurality of steps located between the rails. Pairs of ladder frame rails are connected by support or pivot rods, similar in form to the rungs of a conventional ladder, to form a front frame and a rear frame. In the preferred embodiment, the support rods are welded to the frame rails. In alternate embodiments, the support rods fit through apertures in the rails and are secured to the rails by welds, mechanical fasteners such as threads and nuts, or cotter pins. While the support rods may be free to rotate with respect to the ladder rails, it is not necessary. The platform or steps of each ladder link the front frame and the rear frame. The ladder frame rails attach to the brackets of the base with pivot rods welded to the ladder frame rails. In other embodiments, other means of attachment, such as rivets, nuts and bolts, pins, or other fasteners can be used to pivotably attach the rails to the base.

The steps or platforms of the ladder are free to rotate about or hinge around the support rods connecting the ladder rails. The pivot arrangement may be improved by means of fitted bushings. The steps are made of a center brace, two end brackets and three support brackets with a tread plate on the top side of the bracket weldment. The steps are secured to the frame with support or pivot rods inserted through the steps and welded to the frame rails. At the ends of the ladder

frame are four locking brackets that engage the lock pins to secure the assembly in the ramp or scaffold function.

When assembled, the ladder is adjustable so that it may be inclined at different angles with respect to the ground while allowing the platform steps to remain generally parallel to the base of the assembly, which is intended to be placed on the ground. As the ladder frame rails rotate with respect to the base, the steps and base act to keep the four rails parallel at any pitch angle. When the ladder is collapsed, the steps line up to form the surface of a scaffold or ramp.

At or near the top end of the ladder frame, various attachments can be added for certain applications, allowing the ladder to attach to or interface with another object, such as a rail on the side of a farm implement or a receiver mounted on a flatbed trailer. Of course, the ladder can be deployed free-standing against a wall or other structure, or attachments such as hooks, a roller and track configuration or a bracket assembly for securing to a flatbed type semi trailer. Pneumatics or hydraulics could also be implemented to actuate one pair of the rails to quickly flatten the ladder to make a ramp or slide. In other embodiments, supports or jacks between the ladder rails and the ground or other reference surface can be used to secure the ladder at a particular inclination.

The ladder is also constructed to receive accessory bars that allow features to be selectively attached and removed from the ladder. Specifically, the accessory bars equipped with a headrest and swivelable wheels, disclosed herein allow the ladder, when in the stowed or platform configuration, to be used as a creeper for accessing height restricted areas such as the underside of a trailer, car, or truck. Other accessory bars can include non swivelable wheels such as those mounted on an axel extending across the accessory bar or also included an upright handle that is selectively locked in an upright or first position, but allowed to pivot between the upright and horizontal position when unlocked. Providing the wheels and handle allow the ladder, when in the stowed or platform configuration, to be used a hand cart or trailer.

The ladder of the present invention can be described as having three main components:

1) Ladder frames
2) Ladder base and steps
3) application/attachment assembly

1) Ladder Frame:

Components of ladder frames include a plurality of rails, and a plurality of support rods. In the preferred embodiment, four rails are used. The support rods connect pairs of rails, in a fashion similar to ladder rungs, to form what are akin to two normal ladders. The spacing of the support rods can vary depending upon the application of the ladder. The spacing of the support rods on each frame will be similar, so that the steps linking the two ladder frames will maintain the same angle with respect to each other. The two ladder frames are linked by the base and steps, the support rods pivotably or hingedly supporting the platform steps. Components of ladder frame can be assembled in a manner that when in an unfolded working position at a 45 degree pitch, ladder will give the appearance of a flight of stairs.

In addition, when the ladder frame is in a folded position or storage position, it can be used as a ramp or scaffolding, as the steps of the ladder fold to lie in a generally planar arrangement between the rails.

2) Ladder Base and Steps:

The bottom of the ladder frame pivotably attaches to brackets on the ladder base. The base includes brackets that are offset in height. The offset allows one set of frame rails

to overlie another set of frame rails, allowing the ladder to fold and form a platform or scaffold surface. Once the frame is attached to base and steps are attached to the support rods, the ladder may be set at different angles, and the steps will remain parallel to the base. While the brackets may be placed at the corners of the base, it is advantageous to have the based extend some distance in front of the front set of brackets. The extension of the base provides leverage to resist the torque that may be generated by loads on the steps of the ladder when the ladder is in use. The base may also include handles on its periphery to allow ease of carrying. The handles can also provide the user a convenient handhold when deploying or stowing the ladder when the ladder is used in a track mounted configuration.

The ladder base will also provide secure footing for the ladder assembly in addition to having a locking device to be used when ladder is in a folded down position for use as a ramp or for storage. The ladder base is optional, and a ladder consistent with the invention described herein can be constructed without a base. In such an embodiment, the locking mechanism to lock the two ladder frames together is located on the steps, or on the rails.

In a ladder that does not have a base, the steps link the two ladder frames. In such an embodiment, the ends of the rails may include height adjustment devices to assist in leveling the ladder frames on uneven ground.

The linkage provided by the base and steps allows the ladder of the present invention to be used at an infinite number of pitches between 0-90 degrees, since the angle formed by the rails with respect to the ground may change, although the platform steps remain parallel to the ground and to each other. When viewed from the side, the frame rails and the steps form a parallelogram.

The ability to keep the steps parallel is of benefit if the top of the ladder is fixed to a piece of machinery, such as a farm implement or flatbed trailer. The ladder can be deployed to varying levels, such as the ground or a pickup truck bed, while the steps remain parallel to the ground in either instance.

Additionally, the ladder, when in folded so that the ladder rails lie against one another, or so the base and the rails are parallel, the steps form a generally planar surface, so that the ladder can be uses as a platform or a ramp.

3) Application/Attachment Assembly:

In some applications, the top end of ladder simply rests freely against the work area. However, the ladder of the present invention can accommodate optional attachments at the top end of ladder, allowing the ladder to be more securely fixed to an object or work area. Such attachments described herein allow mounting the ladder to all types of machinery, vehicles, and buildings etc. Application/attachment assemblies may consist of one or a combination of the following. 1) Hooks attached to top of ladder may be used to secure ladder to a rod on any given fixed point. 2) Square, rectangular, round tubing or post material or any combination may be pivotably attached to the ladder, allowing the post to be placed in a suitable receiver on the work area. An example of such a receiver would be a vertical hole, receiver, or stake pocket in the frame of a flatbed trailer; 3) Any other form of receiver that will firmly secure ladder to any fixed point; 4) pads to protect any surface that the ladder rests against; 5) wheels.

The above assemblies may also be used on both of ladder ends so as when ladder is in a closed or folded position, it can be used as a form of scaffolding or ramp between two fixed points. In particular, the attachment of wheels and a headrest to the ladder in the folded configuration will allow the structure to be used as a creeper or dolly. The attachment of a handle would allow the structure to be used as a cart.

The additional assemblies or accessories may be placed on accessory bars that are selectively attached and detached from receivers on the ends of the ladder.

The ladder assembly may be made of one or more of the following materials; aluminum, steel, fiberglass, wood, composites, or any other material of suitable strength and durability.

The length of ladder assembly can be as long as desired, but also remaining within an acceptable standard of safety. Lengths will be determined according to application.

The width of ladder can also vary according to application and desire while remaining within a standard of safety.

Step construction: standard placement of step assembly within ladder frame is preferred to be 12" center to center as it is on conventional ladders from rung to rung. This can also deviate from standard if desired. Step assembly depth or length shall also be as desired. If ladder is to be used as a ramp it is preferred that the depth/length of the steps shall be great enough to allow steps to meet or nearly meet end to end while in folded position so as to form a generally planar, nearly continuous surface. Step assembly depth/length can be decreased if desired to allow more spacing between the steps or individual platforms when the ladder is folded.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view of the ladder in a deployed configuration.

FIG. **2** is a perspective view of the ladder in a stowed or scaffold configuration.

FIG. **2***a* is a close-up partial perspective view of a portion of FIG. **2**.

FIG. **3** is an underside partial perspective view of a representative step assembled on the ladder.

FIG. **4** is a top perspective view of a step.

FIG. **5** is a top partial perspective view of the base and bottom step assembled on the ladder, the foot support surface of the step removed.

FIG. **6** is a top perspective view of a base.

FIG. **7** is a top partial perspective view of the top step assembled on the ladder.

FIG. **8** is a top partial perspective view of the top of the ladder with a staker.

FIG. **9** is a top partial perspective view of the top of the ladder attached to rollers and track.

FIG. **10** is a top perspective view of a base having stability extensions and handles.

FIG. **11** is a perspective view of a ladder with supports to adjust the inclination of the ladder.

FIG. **12** is a perspective view of a ladder with supports to adjust the inclination of the ladder and a handrail.

FIG. **13** is perspective view of a ladder with supports to adjust the inclination of the ladder, a handrail, and a wheeled base.

FIG. **14** is a partial perspective view of a linkage for adjusting the inclination of the ladder.

FIG. **15** is a top plan view of an infinitely adjustable linkage mounted on the ladder.

FIG. **16** is a side elevational view of an infinitely adjustable linkage mounted on the ladder.

FIG. **17** is a partial perspective view of a ladder fixed to an object and having adjustable actuators to adjust the level of the steps.

FIG. **18** is a side view of a ladder rail having a height adjuster.

FIG. **19** is a perspective view of a shortened ladder in the deployed position with the base side members having receivers for receiving accessory bars.

FIG. **20** is a perspective view of a ladder in the stowed position with a first unmounted accessory bar including a headrest and swivelable wheels and a second unmounted accessory bar having swivelable wheels.

FIG. **21** is a perspective view of a ladder in the stowed position with mounted accessory bars.

FIG. **22** is a perspective view of a ladder in the stowed position with a first mounted accessory bar having a lockable and pivotable handle positioned in an upright position and wheels, and a second mounted accessory bar having wheels.

FIG. **23** is a perspective view of a ladder in the stowed position with a first mounted accessory bar having a lockable and pivotable handle and wheels, and a second mounted accessory bar having wheels.

FIG. **24** is a partial perspective view of a hitch connected to the handle of the ladder shown in FIGS. **22** and **23**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The ladder **10** includes four ladder rails **15***a-d*, each having a top end **16***a-d* and a bottom end **17***a-d*. Each rail **15***a-d* is pivotably connected at their bottom ends **17***a-d* to a base **18**. In the preferred embodiment, the rails **15***a-d* are square metal tube stock, although other materials, such as solid stock, I beams, angle iron, channel stock, fiberglass, composites, and lumber, could be utilized to form the rails. It is not necessary that the rails be of tube stock. While the rails are square in the preferred embodiment, they may also be of any convenient shape. The length of the rails can vary, although for flatbed trailer applications, it is preferred that the rails be at least **60** in length. It is preferred that at least two of the ladder rails extend 48 inches above the top most step, here step **20***a*, to provide for a hand grip when a person is on the top most step **20***a*.

Each rail **15***a-d* is pivotally attached to a plurality of steps **20***a-g* positioned at generally equal intervals between the rail top ends **16***a-d* and the rail bottom ends **17** *a-d*. The intervals closely match the length of the steps **20**, so that the steps form a nearly continuous surface when the ladder **10** is in the folded or ramp configuration shown in FIG. **2**. In the preferred embodiment, the steps **20** are seven in number and are approximately 12 inches square.

The steps **20***a-g* are pivotally attached to the rails **15***a-d* by support rods **25***a-n* that extend between pairs of rails, much like the rungs of a traditional ladder. So constructed, the ladder has a first frame **11** and a second frame **12** linked together by the plurality of steps **20***a-g*. In the embodiments shown in the figures, support rods **25** *h-n* connect rails **15***c* and **15***d* to form the first frame **11**. The support rods **25***a-g* connect rails **15***a* and **15***b* to form the second frame **12**. The support rods **25***a-n* fit through apertures in the rails **15***a-d* and are secured at their terminal ends by welding the support rod ends to the outside surface of the rail. It is also possible to weld the rods at any area in which the rod and the rail contact each other. In other embodiments, the support rods need not go through apertures in the rails, but may be attached to brackets attached to the exterior surface of the rails, or attached to the surface of the rails themselves without the need for brackets. One skilled in the art will recognize that there are may ways to attach the rods to the rails so that the rods will support the steps **20** *a-g* and allow the steps to move relative to the rails as the angle of the rails with respect to the ground is changed.

In other embodiments, the steps **20***a-g* are fastened to the rails **15***a-d* by fasteners, such as nuts and bolts, rivets, pins, or other fasteners known in the industry. In such embodiments, the steps **20***a-g* in conjunction with the fasteners act to connect the rails to each other.

The steps **20***a-g* are shown in detail with reference to a single step in FIGS. **3-5**. The steps **20** are generally 12 inches square, but one skilled in the art will recognize that the dimension of the steps may be change to suit the application. Each step includes a frame **21** formed by a pair of side members **22***a* and **22***b* spaced apart by cross members **23** *a-c*. The members are preferably joined by welding. A tread plate or other foot support surface **28** overlies the frame **21**.

The side members **22***a* and **22** *b* include apertures to accept a support rod **25**. The side members **22***a* and **22***b* can be "L" shaped to allow pairs of apertures **26***a-b* and **27***a-b* to be offset vertically. The vertical offset is generally the same as the height of a rail, the offset allowing the rails to lie against or in close proximity to one another when the ladder **10** is in the folded, collapsed, storage, or ramp configuration shown in FIG. **2**. In other embodiments, be side members can be straight, and include downwardly extending brackets to produce the offset. A bushing **121***a-d* may be placed in the apertures to allow the step **20** to rotate about the rod **25** in an improved fashion. The steps may be spaced apart form the rails by spacers that fit over the rods, the spacers having a diameter larger that the diameter of apertures in the brackets attaching the steps to the rods so as to keep distance between the rails and the steps.

In alternate embodiments, the brackets are planar metal members with an aperture to accept the rods **25**, or other fastener, and thereby allow the step **20** to rotate with respect to the rod **25** or other fastener. In alternate embodiments, the bracket **30** may be fixed to the fastener, rod **25**, or other member, and the fastener allowed to rotate with respect to the rail **15**. The apertures in the brackets are offset vertically by a distance equal to the overall height of one rail. The bracket will also allow a surface for welding the support rod in a metal construction.

The offset of the apertures **27***a-b* and **27***a-b* in the side members **22***a* and **22***b* is approximately the width of a side rail **15** from front to back. In the preferred embodiment, the offset is approximately 1.25 inches. This offset allows the ladder to form a platform when in the stowed configuration by allowing the rails **15***b* and **15***c* to lie in close proximity or against each other, as shown in FIG. **2**. Thus, the offset is controlled somewhat by the width of the rails and the placement of the apertures in the rails.

In other embodiments, a step **20** may be constructed out of a single piece of material. Such material may include metal, wood, plastic, composites, or any other material known to one skilled in the art. For instance, the step **20** may be made as a blow-molded piece of plastic. Such a step may include reinforcing ribs made of plastic or some other material such as metal, but may not necessarily need such reinforcement. The single piece step may include a first set of apertures and a second set of apertures vertically off-set from the first set of apertures.

The base **18** of the preferred embodiment includes a frame composed of four side members **45***a-d* connected to form a rigid structure. The base **18** is preferably a welded fabrication consisting of two end tubes **45***b* and **45***d* and two side tubes **45***a* and **45***c* of the same stock size as the rails **15***a-d*. One skilled in the art will recognize that other sizes and

materials may be used to construct the base **18**. The end tubes **45***b* and **45***d* and the two side tubes **45***a* and **45** *c* form a frame that is generally rectangular with dimensions allowing that the rails of the first frame **11** will be separated by at least the overall width of one step assembly, and is the foundation for the hinge brackets.

The hinge brackets **50***a-d* connect the four rails **15***a-d* with a minimal amount of free-play, but to allow for free rotation. The hinge brackets holding the first frame **11** are preferably spaced apart on the base **18** from the brackets holding the second frame **12** at the same distance that horizontally separates the apertures on the side member **22**. The hinge brackets **50** *a-d* are generally upstanding planar members that include apertures **56** to accept the connecting rods **25**. The apertures are vertically offset by approximately the same distance as the apertures **26***a* and **27***a* of the steps **20** in order to allow the ladder **10** to fold into a generally flat configuration. In such a folded configuration, the steps **20***a-g* form a support surface. When in a folded configuration the first frame **11** lies over the second frame **12**. In the folded configuration, the first frame **11** is displaced from the second frame **12** in the horizontal direction by the horizontal distance between the apertures **26** and **27** of the step **20** side member **22**.

It is preferred that there is structure to secure the ladder **10** in the folded or platform position shown in FIG. **2**. In the preferred embodiment, the locking structure secures the first frame **11** to the second frame **12**. On skilled in the art will recognize that other components can be secured together to maintain the ladder **10** in the platform or folded configuration.

As shown in FIG. **2***a*, the locking structure includes a lock plate **60** with a slot **61** to engage a locking pin **62** and a hole to attach to one end of one support rod **25**. Such structure can be placed at or near the ends of the rails on both sides of the ladder **10**, as shown in FIGS. **1** and **2**. The lock plate **60** is a generally planar member. The slot **61** is offset from the hole a distance equal to the overall height of one rail **15**, and is shaped so that the slot **61** is a small section of a circular arc of a radius that is equal to the overall height of one rail **61**. This will allow the lock plate **60** to engage the lock pin **62** smoothly over an angle of approximately 16 degrees. In this arrangement, the support rod **25***g* is not fastened to the bracket **50***a* or rail **15**, but directly to the lock plate **60** itself allowing for free rotation of the entire length of the support rod **25***g*.

The top end **16***a* and **16***b* of the rails **15***a* and **15***b* may include accessories to allow the ladder **10** to attach or interact with work surfaces or other objects. The top ends **16***a* and **16***b* need not be the extreme terminus of the rails **15**, but are generally beyond the midpoint of the rails. The top ends **16***a* and **16***b* may include hooks **70***a* and **70***b*. The hooks **70***a* and **70***b* may be formed as an integral part of the rails **15***a* and **15***b*, or be separate components attached to the rails by welding, fasteners, or other means or structures known in the art to attach components together.

The top end may also include brackets **72***a* and **72***b* to accept a generally "T" shaped stake or post **75**. The post **75** is a structure that allows the ladder to be fixed to another structure such as a flatbed trailer. The post **75** includes a portion that is affixed to the other structure and a second portion that is allowed to rotate with respect to the rails **15** of the ladder **10**. In the preferred embodiment the post **75** includes a horizontal portion that is free to rotate in the brackets **72**, thus allowing the post **75** to rotate with respect to the rails about an axis that is parallel to the plane of any one of the steps **20***a-g*. The post **75** has a downwardly extending appendage **76** that can be accepted by a receiver **90**, such as a hole in the frame of a flatbed trailer. One skilled in the art will recognize that other receivers can be used to accept the post **75** and that other configurations can be used for the r post such that the post can be fixed to an object and allow the ladder to rotate about the post **75**.

The top ends **16***a* and **16***b* may include wheels **80** or other rolling members. The wheels **80** can interact with track **78** mounted to a work surface such as a piece of heavy equipment or flatbed trailer. The track is preferably mounted in a horizontal position, with an end **79** presented or exposed to a user. The track has a length that is preferably equal to the length from the place on the rail that the wheel is mounted to the base of the ladder. This arrangement allows the ladder to be placed in its flat or stowed configuration and then slid along the tracks **78** to be stowed. In such a stowed configuration, the ladder **10** can also be used as a work platform, as the tread plates **28** of the steps **20***a;g* will form a generally planar surface.

In an alternate embodiment shown in FIG. **10**, the base **118** can include an extension **120** that extends in front of brackets **150***c* and **150***d*. Described another way, the brackets are not placed at the corners of the base **18**, but are instead displaced from the corners. The extension **120** may include handles **160***a* and **160***b*. Handles **160***a* and **160***b* may be placed on the sides of the base **118**. In other respects, the base **118** is similar to base **18**.

In alternate embodiments as shown in FIGS. **11-13**, the ladder **210** can be supported by supports **290***a* and **290***b*. The supports have one end pivotably attached to the ladder frame rails **215***a* and **215***b*, preferably at the rail top ends to improve leverage. However, they may be positioned anywhere along the length of the rails, or may be pivotably attached to any other members of the ladder frame.

The supports **290***a* and **290***b* can be adjusted to vary the inclination of the ladder **210**. The supports **290***a* and **290***b* can be adjusted by allowing first support members **291***a* and **291***b* to slide within the second support members **292***a* and **292***b*. The sliding members may be fixed in place by a pin placed in apertures, locking collars, or other means known to secure sliding members. In other embodiments, the supports may be pneumatically or hydraulically operated.

The alternate ladder may include a handrail assembly **280** shown in FIGS. **12** and **13**. The handrail assembly **280** includes a first upright or stanchion **281** fixably mounted to the uppermost step, and a second upright or stanchion **282** fixably mounted to the base **210**. The stanchions are pivotably connected to a handrail **285** that extends there between.

In other embodiments, the ladder, such as the ladder **210**, can be mounted on a wheeled frame **300**, to allow the ladder to easily be moved from place to place. The wheeled frame **300** includes wheels **310** mounted near the corners. The frame includes brackets **395** to pivotably mount the supports **290***a* and **290***b*.

In any of the ladder embodiments, the ladder may be locked in a particular inclination using a linkage **370** between the ladder side rails such as between **15***a* and **15***d* or **15***b* and **15***c*. Such linkage links the first frame **11** to the second frame **12**. As shown in FIG. **13**, the linkage **370** is pivotably attached to side rail **15***c*, and extends to side rail **15***b*, where one of a plurality of slots **375** engages a pin **380** to selectively lock the ladder inclination. One skilled in the art will recognize that other mechanisms or structures can be used to lock or otherwise secure the inclination of the ladder.

An alternative linkage that allows infinite adjustment is shown in FIG. **15**. The alternate linkage includes a first slotted linking member **471** and a second slotted linking

member **472**, each liking member having a slot to sunning the length of the linking member. The linking members **471** and **472** are arranged on either side of rails **15***a* and **15***d* so that the rails are between the linking members **471** and **472** and the slots of the linking members are aligned with each other. The linking members **471** and **472** are secured to the rails **15***a* and **15***d* by fasteners such as nuts **410** and bolts **420**. Other fasteners can be used so long as the linking members are allowed to pivot with respect to the rails **15***a* and **15***d*. In the preferred embodiment, the connection between the linking members **471** and **472** and rail **15***a* allows pivoting, but does not allow the fastener to move along the slot. Thus the ladder rail **15***a* is translationally fixed with respect to the linking members **471** and **472**. Rail **15***d* is not translationally fixed with respect to the liking members **471** and **472**, and the fastener is allowed to slide in the slots of the linking members **471** and **472**. In order to restrain or limit the translational movement, a stop **480** is placed in the slot. The stop **480** can be a nut and bolt. In the preferred embodiment, the stop **480** is a cam action lever clamp that allows the user to selectively secure and unsecure the stop at a position in the slot. The cam action lever clamp includes a stud or post **481** that is inserted in the slot and a cam action lever **482** that attaches to the post **481**. A spacer **484** is paced about the post **481** to allow the clamp to grasp the linking member **472** between the lever **482** and the spacer **484**, and linking member **471** between the post **481** and the spacer **484**. To improve friction, the inside surfaces of the linking members **471** or **472** or the spacer **484** may include surface features such as ridges, grooves **485**, or other structures to increase friction.

In another embodiment, shown in FIG. **17**, the second frame **12** is fixed or attached to another object so that the first frame is allowed to pivot about the attachment. In the embodiment shown in FIG. **17**, the support rod **25***g* is fixed in place so that the second frame **12** can pivot with respect to it, but is fixed in other degrees of freedom of movement. The first frame is pivotably connected to adjustable actuators **700***a* and **700***b*. The adjustable actuators **700***a* and **700***b* are fixed to an object such as the object fixed to the second frame **12**, or to yet another object such as the ground. The adjustable actuators are then used to adjust the angle of the steps **10** by moving the first frame **11** with respect to the fixed second frame **12**.

The ladder **10** may be constructed without the base **18**. In such an embodiment, it may be useful to have the bottom ends **17***c* and **17***b* of the rails **15***c* and **15***d* of the first frame **11** be slightly longer than the bottom ends **17***a* and **17***b* of the rails **15***a* and **15***b* of the second frame. The extra length will depend upon the vertical offset used on the steps **20**. The additional length allows for the steps to be level when the ladder **10** without the base **18** is placed on level ground. The vertical off set is typically the height of one rail **15**, as previously discussed.

The bottom ends **17***a-d* of the rails **15***a-d* may also include height adjusters. A representative height adjuster **750** is shown in FIG. **17**. While only one adjuster is shown, it may be applied to any of the rails **15***a-d*. The adjuster **750** operates by allowing an adjuster support member **751** to slide within the rail **15**. The support member is sized **751** to fit within the rail **15**. The support member **751** and the rail are fixed in place by a pin placed in an aperture **752** in the rail **15**, and in one of a plurality of apertures **755**. In other embodiments, locking collars, or other means known to secure sliding members may be used. In other embodiments, the supports may be pneumatically or hydraulically operated. When the ladder **10** is used without the base **18**, the adjuster support member **751** will contact the ground or other surface. When used with a base **18**, the adjuster support member **751** may include an additional aperture **760** for attachment to the base **18** in the place of the bottom ends **17***a-d* of the rails **15***a-d*.

With reference to FIGS. **19** through **24**, another embodiment of the ladder **10** is shown. In this embodiment, the ladder **10** includes structure to allow the ladder **10** to be converted into a creeper or a cart when in the platform configuration by the attachment of accessory bars **600** to the rails **15** and base **18** of the ladder **10**. With the use of accessory bars **600** placed in suitable receivers on the ladder **10**, wheels, pads, hooks, or other structures that may be used with the ladder in the ladder **10** or in the platform configuration can be selectively attached or removed from the ladder **10**. In other embodiments, the accessories, such as wheels, pads, hooks, or other structures may be placed on posts that connect to only one receiver.

As shown in FIG. **20**, the accessory bars **600** attach to the ends **16***a* and **16***b* of the ladder rails **15***a* and **15***b* or to the base **18**. When the ladder rails **15***a* and **15***b* and base **18** are made of tube stock, the ends of the ladder rails **16***a* and **16***b* are open to receive the accessory bars **600**. Being open, they form receivers to receive the accessory bars **600**.

When the ladder rails **15***a* and **15***b* are used to receive the accessory bar **600**, they may only do so when the ladder **10** is in the platform configuration, thus exposing the first ends **16***a* and **16***b*. When the ladder is deployed, the base **18** prevents the first ends **16***a* and **16***b* from receiving the accessory bar **600**.

When other materials are used for construction of the ladder **10** such that the ends are not open to form receivers the ends **16***a* and **16***b* and base **18** are equipped with receivers, such as lengths of open square tube stock attached to the ladder rail ends **16** or the base **18**. The accessory bars **600** are sized to fit into the open ends of the tube stock. The accessory bars **600** are preferably held in place on the ladder by removable locking pins **630** that fit into holes in the ends of the ladder rails **16***a* and **16***b* and base **18**. The accessory bars **600** have corresponding holes that align with the holes in the ladder rails **16***a* and **16***b* and base **18** when the accessory bars **600** are in place, allowing the accessory bars **600** to be selectively secured. One skilled in the art will recognize that other structures can be used to selectively attach and remove the accessory bars **600**.

FIGS. **19-24** show a ladder **10** of the present invention, but one that is shorter than the one shown in FIGS. **1-17**. In this embodiment, which is merely an example, the ladder **10** has for steps **20***a-***20***d*. The base **18** of the ladder is also modified, but the ladder **10** is otherwise similar in construction and components. The base **18** of the ladder **10** of the embodiment shown in FIGS. **19-24** also has the tube members **45** forming the base **18**, the end tubes **45***b* and **45***d* placed so that the open ends **640** of the end tubes **45***b* and **45***d*_face towards the front of the ladder **10** rather than the sides. In such a position, the open ends **640** form receivers for the receipt of the ends or posts **620** of the accessory bars **630**. Such a base **18** configuration could also be used on the Ladder **10** shown in FIGS. **1-17** as well.

The accessory bars **600** in the basic form include a cross member **610** and two posts **620**. In the preferred embodiment, the cross member **610** and posts **620** span the width of the ladder **10** from ladder rail to ladder rail, or across the width of the base **18** for an accessory bar **600** that is attached to the base **18**. In the preferred embodiment, the ladder rails

15 are positioned at the same width as the base 18, so an accessory bar 600 that fits the base 18 will also fit the ladder rails 15.

The posts 620 are positioned on the cross member 610 so that the posts 620 will fit into the ends of the ladder rails 16*a* and 16*b*, or into receivers on the ladder rails 15. The posts 620 extend from the cross member 610 approximately 5 to 8 inches and are preferably positioned at right angles to the cross member 610. One skilled in the art will recognize that the posts 620 can be of different lengths and need not be of the same length. The length of the post 620 also need not be 5 to 8 inches, and the length may be longer or shorter, although it is preferred that the posts 620 fit into the rails 15, base 18, or receiver for at least three inches so to provide stable and secure attachment.

As shown in FIGS. 20 and 21, the accessory bars 600 include pivoting wheels or casters 645 to allow the ladder 10 to be used as a creeper. The wheels 645 preferably are low profile and are positioned near the corners of the accessory bar 600 to allow for a more stable platform. One of the accessory bars 600 includes a headrest 650. The headrest 650 is preferably attached by a bracket 647 to the accessory bar 600 that attaches to the base 18. In the preferred embodiment, the bracket 647 elevates the headrest 650 from the accessory bar 600 so that the headrest 650 is positioned above the step 20*d* when the accessory bar 600 is attached to the ladder 10. In the preferred embodiment, the headrest 650 is thus displaced both vertically and horizontally from the position of the accessory bar cross member 610. In such a case the headrest bracket 647 is "U" shaped. In other embodiments, the headrest bracket 674 is removable from the accessory bar 600. In such a case, the accessory bar 600 is equipped with a receiver to receive the headrest bracket 647. In other embodiments, the headrest bracket 647 is height adjustable to allow the height of the headrest 650 above the step 20*d* to be adjusted. This may be accomplished by providing the headrest bracket 647 with a plurality of spaced apart apertures, and providing the headrest bracket receiver with a corresponding aligning aperture for the insertion and removal of a locking pin, similar to the arrangement use for the height adjustment of the ladder 10 and shown in FIG. 18.

While the headrest equipped accessory bar 600 has been shown as attached to the base 18, the headrest equipped accessory bar 600 may also be attached to the ladder rails 15*a* and 15*b* at the opposite end of the ladder 10. In such an instance, the non-headrest equipped accessory bar is attached to the base 18.

With reference to FIGS. 22-24, the accessory bars 600 may be equipped with an axel 652 and larger non swiveling wheels 653 to convert the ladder 10 into a cart. Such an example is shown with accessory bar 602. In the preferred embodiment, the axel 652 extends away from the sides of the accessory bar 602. In other embodiments, one or all of the accessory bars 600 includes swivelable wheels 645 to allow easy maneuverability of the cart. For instance a first accessory bar 602 will include non swiveling wheels 653 on an axel 652, and the other accessory bar 601 will include swivelable wheels 654 such as casters. In any of the cart embodiments, one of the accessory bars 600 will include a handle 660. In the figures shown, the handle 660 is attached to the accessory bar 601 that includes swivelable wheels 654. The handle 660 is pivotably attached to be placed in a secured upright position, and also be allowed to pivot downward when the locking mechanism is released. It is preferred that the handle 660 freely be allowed to pivot in the unlocked position to allow the handle 660 to be placed a varying heights when connected to a hitch 662, as shown in FIG. 24, for use of the ladder 10 as a cart that is towable by a tractor or other conveyance having a hitch 662 or other attachment point.

The embodiments described herein are merely examples and are not meant to limit the scope of the invention.

I claim:

1. A ladder, convertible from a ladder configuration to a platform configuration, including:

a first and second ladder frame, each ladder frame having a first end and a second end, each ladder frame including two rails connected by a plurality of support rods,

a plurality of steps, each step having a foot support surface, each step connected to a respective first support rod selected from the plurality of support rods on the first ladder frame and to a respective second support rod selected from the plurality of support rods on the second ladder frame, each foot support surface having a length perpendicular to the respective first support rod, a distance between the respective first and second support rods connected by the step being substantially equal to the length of the step,

a base pivotably connected at a first base end to the first ladder frame and to the second ladder frame at a first end of the ladder frames, the base including a portion that extends in front of the first ladder frame and ends at a second base end,

a first accessory bar removably attached to the second base end, the accessory bar including a pair of wheels and a second accessory bar removably attached to the second end of one of the first or second ladder frames, the second accessory bar including a pair of wheels,

the first and second ladder frames maintaining a parallel relationship as the ladder is converted from a ladder configuration to a platform configuration.

2. The ladder of claim 1, wherein the first ladder frame and the second ladder frame are linked by a member to lock the ladder at a particular inclination with respect to the base.

3. The ladder of claim 2, wherein the member linking the first and second ladder frames is pivotably attached to at least one of the ladder frames.

4. The ladder frame of claim 3 wherein the member linking the first and second ladder frames includes a slot having a stop, the stop being selectively secured in the slot.

5. The ladder of claim 1, wherein the first ladder frame and the second ladder frame include structures that cooperate to secure the first frame to the second frame when the ladder is in the platform configuration.

6. The ladder of claim 1, where in the ladder includes a staker to secure the ladder to an object.

7. The ladder of claim 1, wherein the second accessory bar includes a headrest.

8. A ladder having a plurality of platform steps, a first pair of rails, a second pair of rails, and a base for resting on the ground, the base having a front and a back, the first pair of rails being pivotably attached to the base at a pair of front pivot brackets and the second pair of rails being pivotably attached to a pair of back pivot brackets, the back pivot brackets positioned at the back of the base and the front pivot brackets positioned a distance from the front of the base so that the base extends in front of the front pivot bracket, the platform steps being pivotably attached to the first and second pairs of rails so that at least two platform steps are parallel to each other when the first and second pairs of rails are pivoted with respect to the base, a first pair of receivers located on a first end of one of the first or second pair of rails, the first pair of receivers adapted to receive

posts of a first accessory bar, the first accessory bar connecting each rail of the one of the first or second pairs of rails, the first accessory bar including a first pair of wheels, and a second pair of receivers located on the base, the second pair of receivers adapted to receive posts of a second accessory bar, the second accessory bar including a second pair of wheels.

9. The ladder of claim **8**, wherein the first accessory bar includes a handle, the handle extending upwards from the accessory bar.

10. The ladder of claim **8**, further including a post pivotably attached to the ladder.

11. The ladder of claim **8**, where in the ladder may be locked at any inclination between 0 and 90 degrees with respect to the base.

12. A ladder convertible from a ladder having platform steps to a platform wherein the steps align to form the platform, the ladder including:

a first pair of rails connected to form a first frame and a second pair of rails connected to form a second frame, and

a plurality of steps each having a respective treadplate, each respective treadplate having a front edge and a rear edge, each steps pivotably connecting the first frame to the second frame at pivoting connections, the pivoting connections located at the front edge and at the rear edge of the respective treadplate, at least two of the plurality of steps remaining parallel to each other as the ladder is converted to a platform,

a base connecting the first frame and the second frame, a first pair of receivers located on a first end of one of the first or second pair of rails, the first pair of receivers adapted to receive posts of a first accessory bar, the first accessory bar connecting the one of the first or second pair of rails, the first accessory bar including a first pair of wheels, and a second pair of receivers located on the base, the second pair of receivers adapted to receive posts of a second accessory bar, the second accessory bar including a second pair of wheels and a headrest, the headrest positioned to lie over a treadplate.

13. The ladder of claim **12**, wherein when converted to a platform configuration, the steps align to form a substantially planar surface.

14. The ladder of claim **12**, wherein the base includes a tubular member having an open end facing a front of the ladder, the open end of the tubular member forming a receiver.

15. The ladder of claim **12**, wherein the first frame lies over the second frame when the ladder is converted to the platform.

16. The ladder of claim **12**, further including the base pivotably connected to the first frame at a bracket of a first height and pivotably connected to the second frame at a bracket of a second height.

17. The ladder of claim **12**, wherein when converted to the platform, the steps pivot from a platform step configuration to a platform configuration wherein the respective treadplates of the steps align in a plane.

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